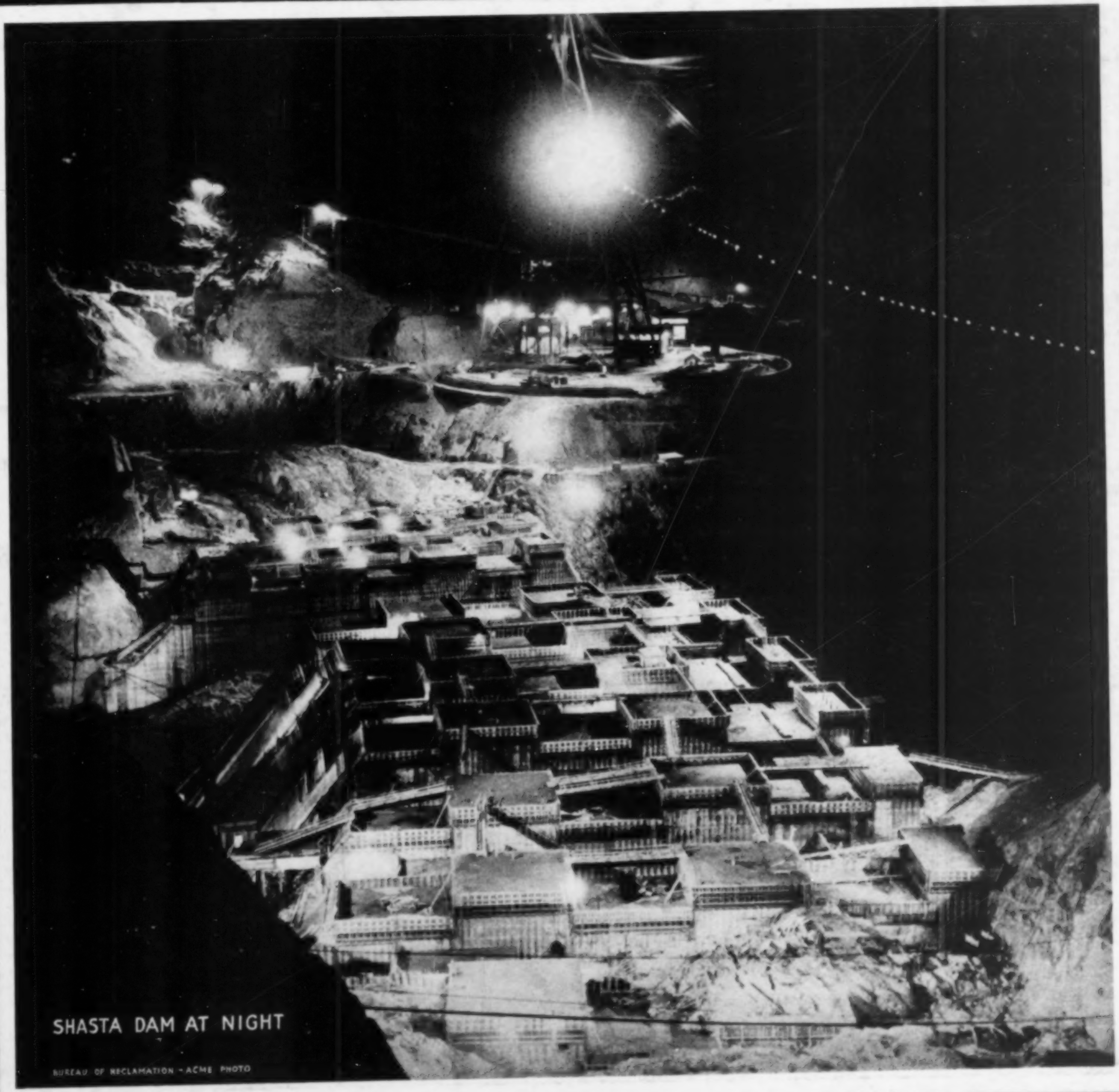
Compressed Air Magazine

VOLUME 46 · NUMBER 6 JUNE 1941 LONDON · NEW YORK · PARIS



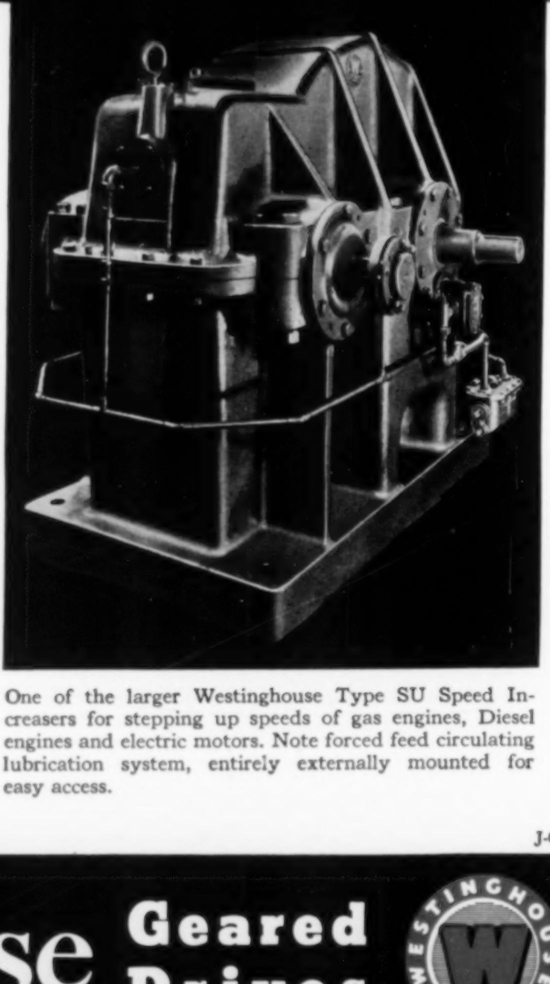
SHASTA DAM AT NIGHT

BUREAU OF RECLAMATION - ACME PHOTO

speed-
INCREASED TO MEET REQUIREMENTS OF DRIVE

No "misfits" or "near fits" with Westinghouse Speed Increasers! Every unit built is designed to fit the exact requirements of the prime mover and the machine it is to drive. Slow speed prime movers—whether Diesel engines, electric motors or gas engines—can be operated at maximum efficiency to drive pumps, blowers, compressors or any similar equipment requiring high output speeds.

Gears cut by the hobbing process on specially built machines—the most accurate yet designed—solve the problem of smooth, quiet operation. Dynamic balancing prevents vibration—forced feed lubrication insures long life. Get full details and helpful application data. Ask for booklet DD-3650. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.



One of the larger Westinghouse Type SU Speed Increasers for stepping up speeds of gas engines, Diesel engines and electric motors. Note forced feed circulating lubrication system, entirely externally mounted for easy access.

J-07189

Westinghouse Geared Drives

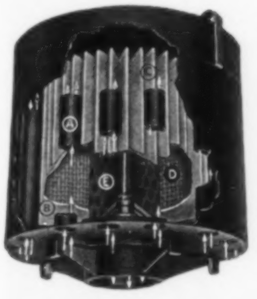
STAYNEW FILTERS

What Does the Name "STAYNEW" Mean? » » » » » » »

1. Less Wear on Engines and Compressors
2. More Service from Air-Powered Tools
3. Longer Lasting Filters

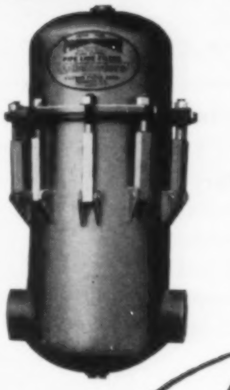
ENGINE AND EQUIPMENT-SAVING FILTERS FOR INDUSTRY

FOR ENGINE PROTECTION



Models D, DS: Permit only clean, dust-free air to be drawn into engine and compressor intake. Model DS features rectifying tubes of scientific diameter to length ratio that "quiets the thump that hurts your ears." Feltex Filtering Medium in Radial Fin Construction provides greatest possible filtering area and efficiency with permanently low restriction to air flow. D and DS Protectomotors make new engines and compressors stay new—add to life and efficiency of old ones.

FOR LIQUID LINES (Including Water)



Models CPHL, CPHLS: Famous Radial Fin Construction applied to the filtration of liquids. Fuel and lubricating oil models remove abrasive matter from oil lines for engines and compressors, preventing excessive wear of all parts lubricated by crankcase oil system; prevent, also, clogging and wear of fuel nozzles. All parts stay new longer. Swing-bolted head if required.

NEW WATER FILTER: An outstanding success everywhere. Used in scores of applications where pure filtered water is a necessity.

FOR COMPRESSED AIR & GAS LINES

Models CP, CPH: Hundreds of thousands in use throughout industry. Guaranteed delivery of clean, dry air, free from dust, dirt, pipe-scale, rust, water. All air-powered tools operate more efficiently, last longer when air supply is kept clean with Protectomotor Pipe Line Filters. Protectomotors often save their cost in a few months. Like all Staynew and Protectomotor filters—easy to inspect, easy to clean, low restriction to air flow, long lasting. Models for horizontal and vertical installation.

Get the Entire Story!

Find out about Staynew and Protectomotor engine and equipment-saving features: Radial Fin Construction—Feltex and Glastex Filtering Mediums—*Double* Counter-clockwise Rotating Curtains—Fire-resistant Wire Kladding, etc., etc. *Catalog describes entire line, including filters for building ventilation.*

WRITE FOR COMPLETE CATALOG

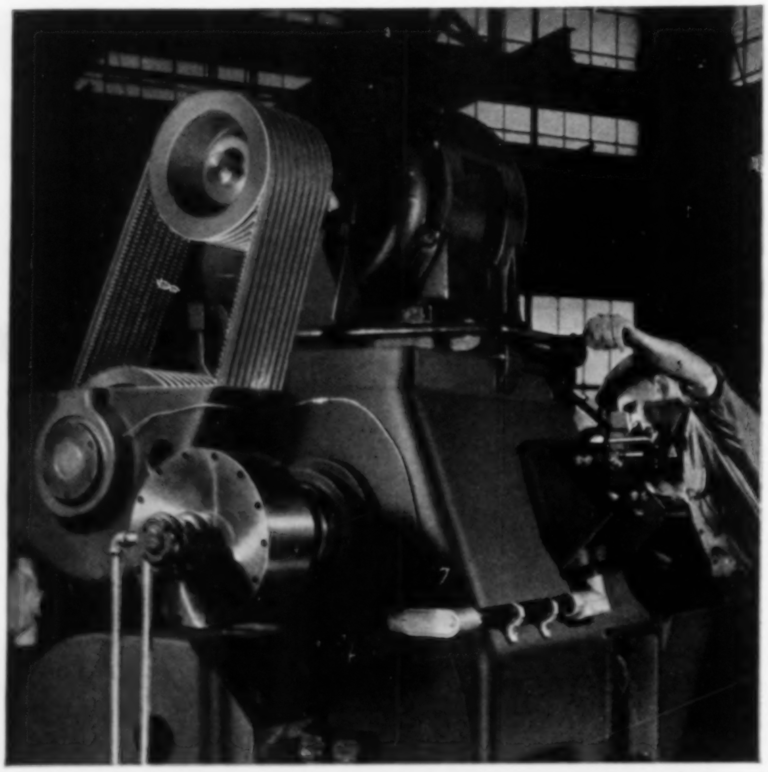
PROTECTOMOTOR
99 9/10 Per Cent Efficient
AIR FILTERS

STAYNEW FILTER CORP.
7 Leighton Ave., Rochester, N. Y.
"Filter Headquarters"

**Today!—When the Pressure is on—
When Machines Must Operate Full Time**

Industry shifts to Dayton

THE GREATEST NAME IN V-BELTS



As American Industry is swinging into high gear, more plants than ever before are turning to Dayton V-Belts for their proved ability to increase output and reduce maintenance costs.

The only V-Belts with patented built-to-bend construction, Daytons operate on short centers to save space and to permit better location of machines for high speed production. With greater gripping power, these smooth-running V-Belts reduce power losses to a negligible minimum and make possible closer speed control.

And because only Dayton V-Belts are made with Daytex Cord in their neutral axis section, they give extra pulling power during their longer life. That's because Daytex Cord has less stretch, is cooler running and has greater strength than the best comparable cord not Daytex processed.

So, right now, decide to prove in your own plant how Dayton V-Belts give longer life, reduce down time and speed up production. Call your nearest Dayton Distributor.

THE DAYTON RUBBER MFG. COMPANY
DAYTON, OHIO
The World's Largest Manufacturer of V-Belts

FOR A LONG PULL and A HARD PULL IT'S...

Exhaustive tests prove that Dayton V-Belts with Daytex Cord have the *extra* strength, *extra* flexibility, *extra* life and *extra* gripping power to deliver plus-power transmission under rigorous conditions at less-cost-per-month-of-service.

The Plus-Value DAYTON V-BELT

1 ✓+ LONGER LIFE.
2 ✓+ STRENGTH.
3 ✓+ FLEXIBILITY.
4 ✓+ COOLER RUNNING.
5 ✓+ GRIPPING POWER.

**Dayton
V-BELT DRIVES**
WITH DAYTEX CORD

Copyright 1941, The Dayton Rubber Mfg. Co.

...few and far between!

IN THOUSANDS of compressor valve "families," "wash-days" for valve cleaning are practically unknown. Month in and month out valves stay CLEAN ... opening wide and shutting tight.

Your compressors, too, will stay on the job, delivering air at full pressure, when you use *Texaco Alcaid, Algol or Ursa Oils.*

Texaco Alcaid, Algol and Ursa Oils are highly stable, resist gumming, sludging and the formation of carbon deposits. They assure more efficient valve action and longer service between inspections and cleanings.

The outstanding performance that has made Texaco preferred in each of the fields listed in the panel has made it preferred by some of the largest compressor operators in the world.

These Texaco users enjoy benefits that can also be yours. A Texaco Lubrication Engineer will gladly cooperate. Phone the nearest of more than 2300 distributing plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York, N. Y.

ROCK DRILL TREATISE—a 36-page booklet of pictures and text to help you keep your rock drills on the job. Yours for the asking.

Texaco Dealers invite you to enjoy FRED ALLEN in a full-hour program every Wednesday night. CBS, 9:00 E.D.T., 8:00 E.S.T.; 8:00 C.D.T., 7:00 C.S.T.; 9:00 M.S.T.; 8:00 P.S.T.

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★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

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★ More locomotives and cars in the U. S. are lubricated with Texaco than with any other brand.

★ More tourists use Texaco *Fire-Chief* Gasoline than any other brand.

★ More revenue airline miles within the U. S. are flown with Texaco than with any other brand.

TEXACO Lubricants
FOR ALL COMPRESSORS AND AIR TOOLS

Ingersoll-Rand
MOBIL-AIR
AIR POWER

In Step With the Times

Here are two new pieces of air equipment that cut costs and are built to stand up on the heaviest of jobs.

A NEW PORTABLE—Consider the remarkable fuel economy of the MOBIL-AIR Portable Compressors —fuel savings up to 40% on an average job. A convertible engine and the new DRILL-MORE regulator gives 15% more air per gallon of gasoline at full load and 83% more at half load.

A NEW JACKHAMER—The new 55-lb. JB-5 Jackhamer permits an average size man to comfortably handle its full power all day long, thereby, producing from 20 to 40% more feet of hole per shift with less upkeep costs.

THE OUTSTANDING WAGON DRILL—Because of its flexibility in drilling rough ground, its hole cleaning ability and its unusual power and low upkeep, the popular FM-2 is the leader in the wagon-drill field.

The I-R line of Jackbits, Paving Breakers, Sharpeners, Diggers, Vibrators, Hoists, Pumps, etc. is complete and enables you to enjoy undivided responsibility by securing your complete compressed air outfit from one manufacturer. Let our nearby representative help you with your problems.

2-41

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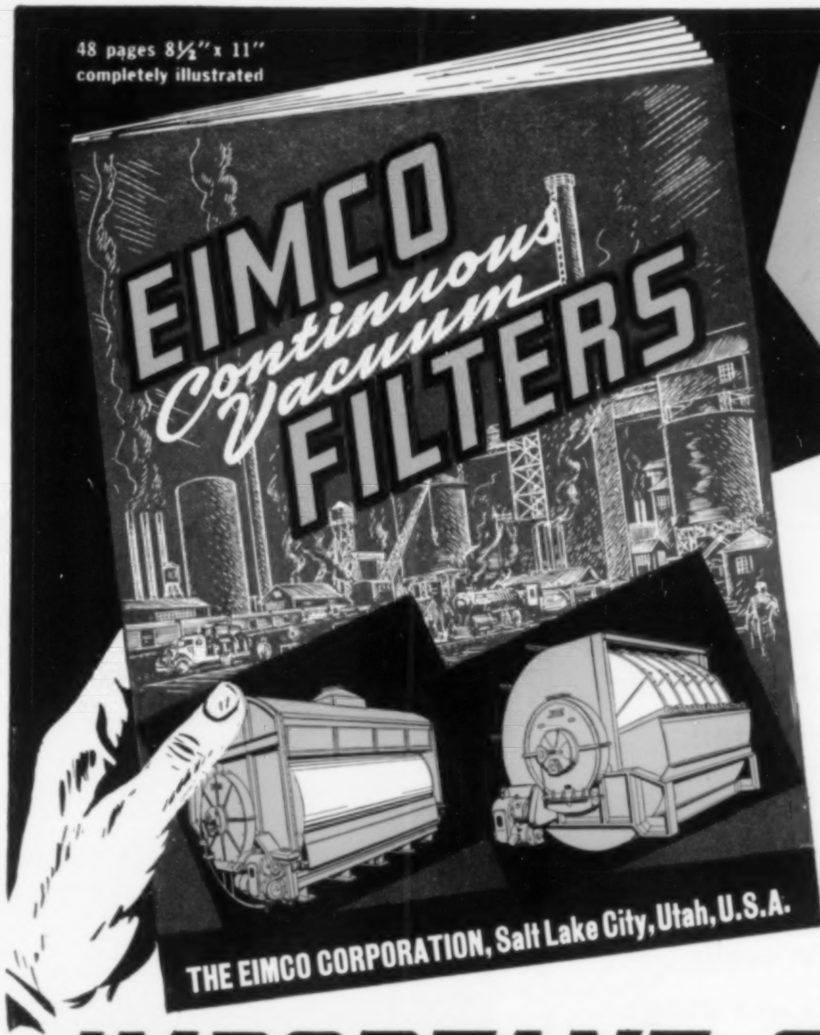
Montreal Mexico Havana Rio de Janeiro Lima London Paris Madrid Lisbon Budapest Melbourne Calcutta Johannesburg and many others.



—just off the press

this NEW text book on Continuous Vacuum Filtration may easily help you to achieve

IMPORTANT SAVINGS

Bulletin No. 404 has been developed to provide metallurgical and chemical-process engineers and executives with complete information regarding not only the constructional features of Eimco Drum, Disc, and Top-Feed Filters, but also regarding the most approved methods of installation and operation. Many typical installations, in a wide variety of industries, are illustrated and explained.

If you are already using continuous-vacuum filters, this booklet should help you to get better results. If you are not yet using them it may prove still more valuable, because wherever solids, liquids or soluble constituents must be recovered from slimes, sludges, pulps, brines, etc., some type of Eimco filter can usually be applied effectively—at a great saving in time and money over settling tanks, filter presses, centrifugals or other intermittent methods of achieving the same results.

Present conditions in the metallurgical and chemical-processing industries make this booklet particularly valuable to every engineer or production executive who is concerned with increasing output, improving purity of product or cutting production costs. Write today for free copy or use the convenient coupon. You'll receive the booklet by return mail.

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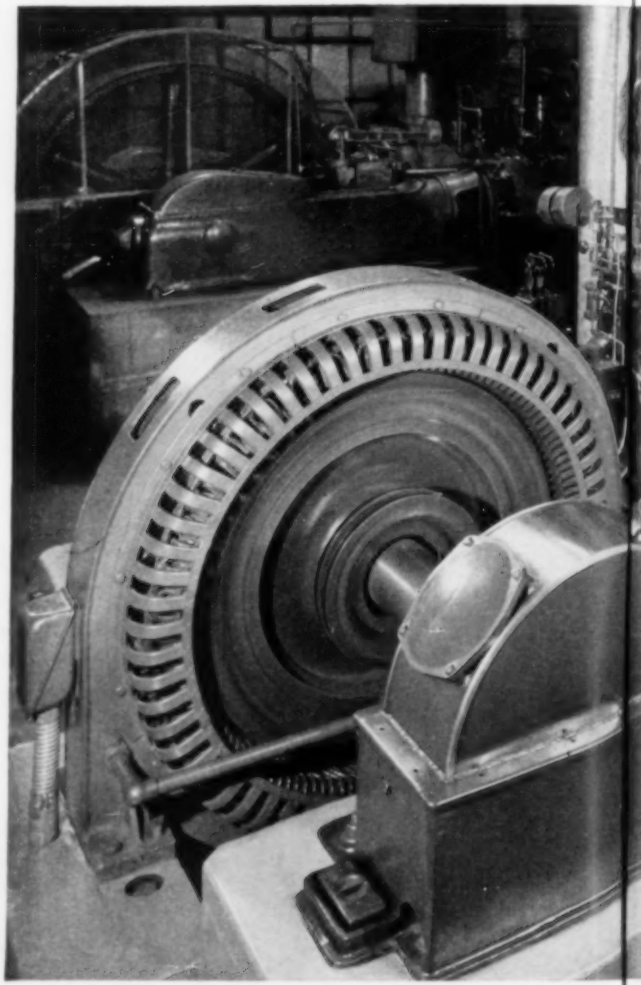

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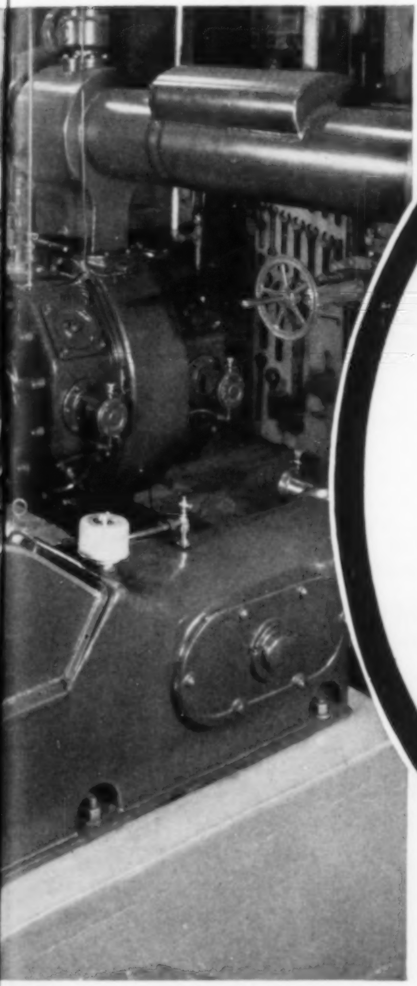

Wherever you see this trade-mark, it means the finest equipment that modern engineering can build, or that money can buy.

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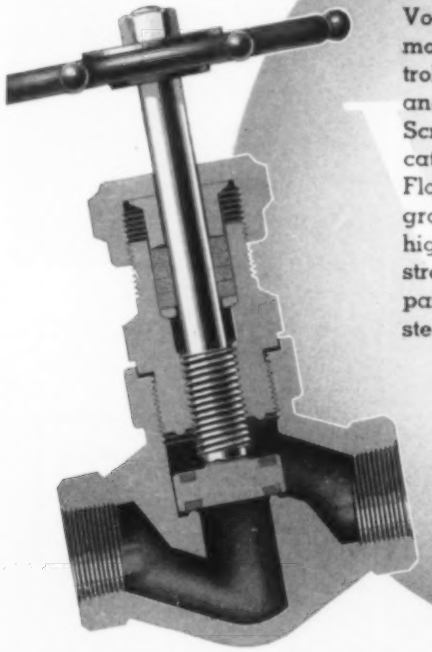
SOUTH MILWAUKEE, WISCONSIN, U. S. A.

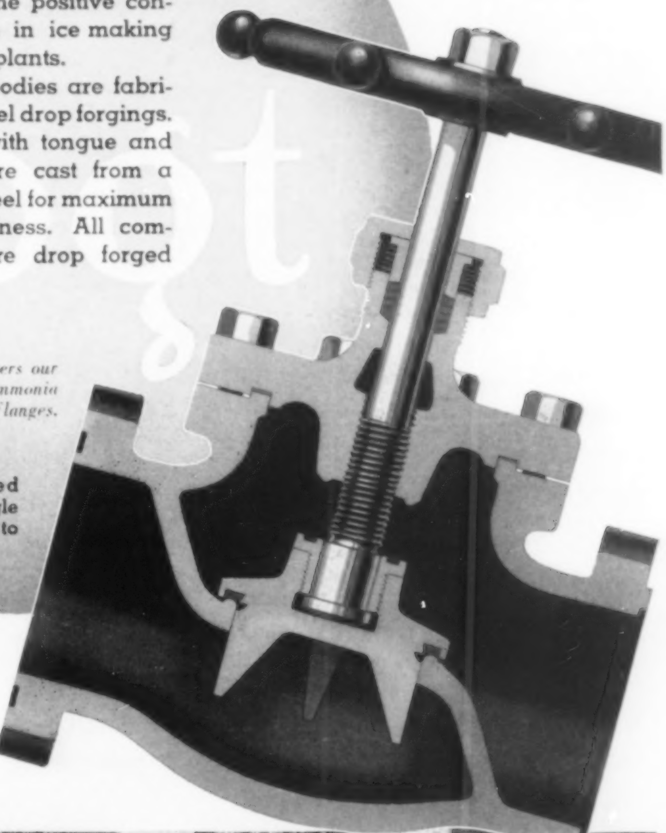
DROP FORGED STEEL AND SEMI-STEEL VALVES FOR ICE MAKING AND REFRIGERATING PLANTS!

Vogt builds a complete line of ammonia valves for the positive control of refrigerants in ice making and refrigerating plants.

Screw end valve bodies are fabricated from solid steel drop forgings. Flanged bodies, with tongue and groove facings, are cast from a high grade semi-steel for maximum strength and tightness. All companion flanges are drop forged steel.



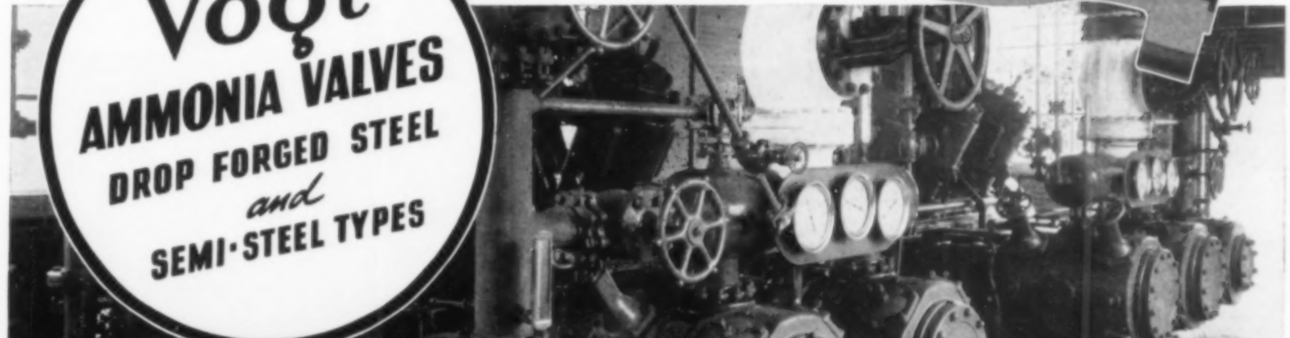
Catalogue AF-2 covers our complete line of Ammonia Valves, Fittings and Flanges.



(Right) **Flanged Globe and Angle Valves from 1/4" to 10" inclusive.**

(Above) **Screw End Globe and Angle Valves from 1/4" to 2" inclusive.**

Vogt
AMMONIA VALVES
DROP FORGED STEEL
and
SEMI-STEEL TYPES



VOGT REFRIGERATION PRODUCTS
include
Complete Compression and Absorption Ice Making and Refrigerating Plants – Ammonia Condensers – Brine Coolers – Ice Can Dumpers and Fillers – Water Tube and Tubular Boilers – Ammonia Valves, Fittings and Flanges.

HENRY VOGT MACHINE CO., Inc., LOUISVILLE, KY. *New York - Philadelphia - Cleveland Cincinnati - St. Louis - Chicago - Dallas*

Just WHAT THE DRILL RUNNERS ORDERED!

The R-58 Stopehamer

Balanced for Easy Handling

The R-58 Stopehamer is built upon the principle that the machine should do the work . . . . . not the man. This is of special advantage in stoping and raise work where ease of operation is of vital importance.

Try this new drill. It will increase the footage drilled per shift. Because of less operator fatigue, you get more production, lower drilling costs and minimum drill repairs.

Weight —— 116 lbs.

Overall Height 59 ins.

Bore — $3\frac{1}{8}$ ins.

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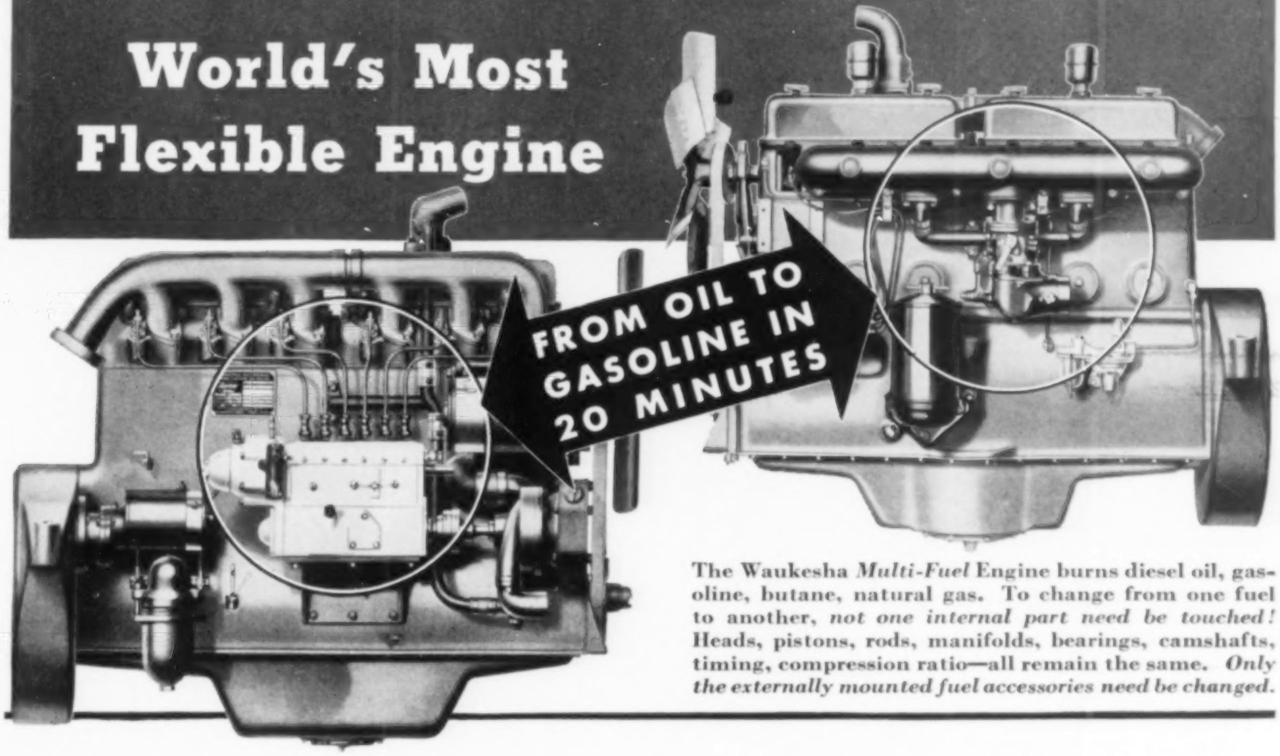
5-5

MULTI-FUEL

World's Most Flexible Engine


FROM OIL TO GASOLINE IN 20 MINUTES

The Waukesha *Multi-Fuel* Engine burns diesel oil, gasoline, butane, natural gas. To change from one fuel to another, *not one internal part need be touched!* Heads, pistons, rods, manifolds, bearings, camshafts, timing, compression ratio—all remain the same. *Only the externally mounted fuel accessories need be changed.*

- Only a contractor can fully appreciate the vast flexibility of this practically universal engine. No matter where you are, the Waukesha *Multi-Fuel* Engine will burn a fuel that you can go out and buy anywhere.

You may be on a job where oil is most economical and easiest to get. Then you jump to a locality where you have every reason to use gasoline.

Do you have to change engines? No, sir! Not when you have a *Multi-Fuel.* You change fuel accessories, that's all. And that can be done quicker and easier than with any engine ever before.

You have your choice of fuels—oil, gasoline, natural gas or butane. Standardizing on *Multi-Fuels,* you can burn one kind of fuel in your trucks—another in your compressor, power shovel, etc.—whichever is most economical for each type of service.

You can even burn distillates or low grade gasoline economically in the *Multi-Fuel.* It uses standard lubricating oils, too. That means exceptionally low operating costs. And maintenance costs are just as low, too.

Ingersoll-Rand power their new Mobil-Air Compressors with *Multi-Fuel.* Other contractors' machinery makers are doing the same. *Multi-Fuel* is the greatest value of any engine the contractor can buy. *Get Bulletins 1160, 1161, 1162.*

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS.
NEW YORK • TULSA • LOS ANGELES

WAUKESHA
Multi-Fuel ENGINES

BULLSEYE by a PAIR OF ACES
PUMP by INGERSOLL-RAND
PACKING by JOHN CRANE
Ingersoll-Rand

Abstract OF INSTALLATION

PROBLEM: Pumping boiler-feed water at 405° F to 420° F; discharge pressure 1550 to 1700 pounds; suction pressure 450 to 500 pounds . . . .

EQUIPMENT: Ingersoll-Rand Cameron Class CHT Multi-Stage Vertically Split Barrel-type heavy duty, high pressure Boiler Feed Pump . . . .

PACKING ADAPTATION: John Crane Style 804-MBF on Nitralloy sleeves . . . .

SOLUTION: 100% performance . . . .

LOCATION: (Data on request).

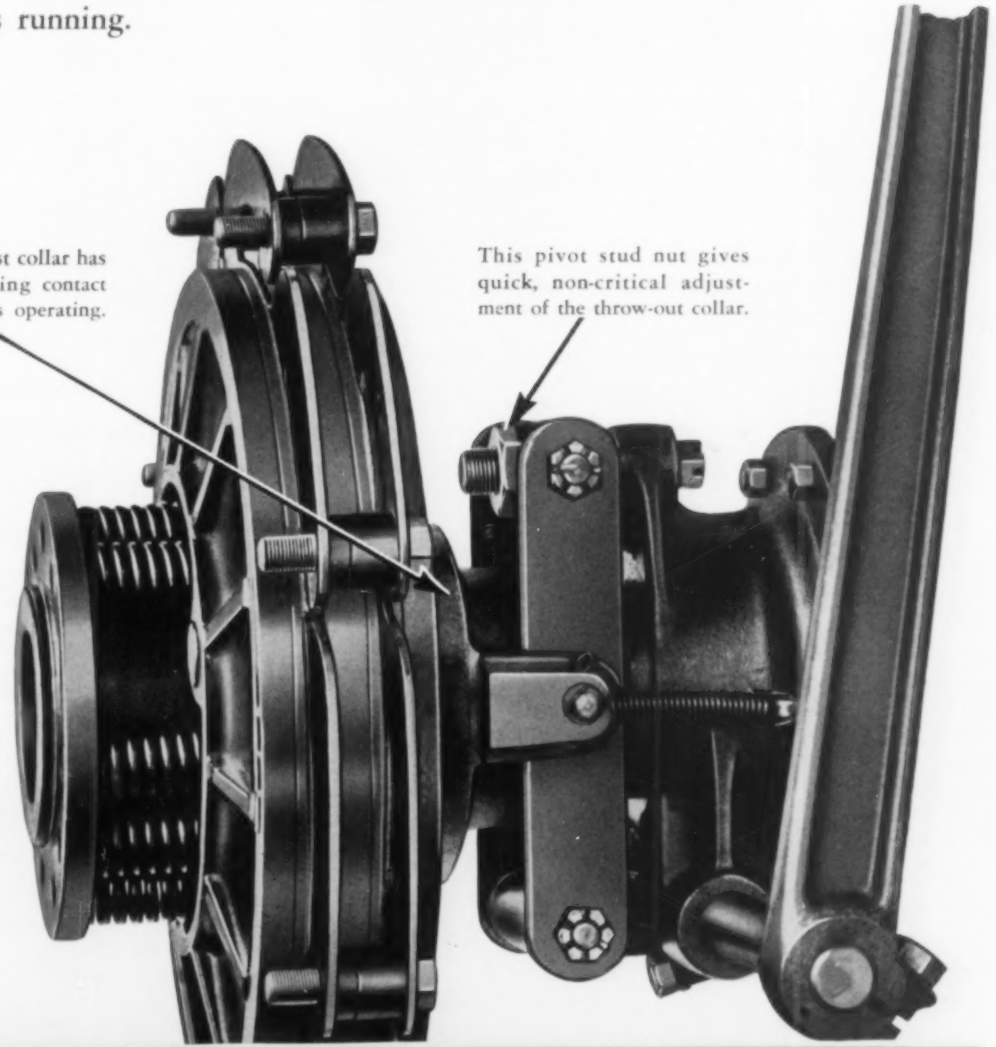
. . . Opportunity is taken here to invite attention to a notable preference for John Crane Packings—one of a long series of "quality" installations where John Crane Style Packing demonstrated spectacular sealing efficiency . . . Yes, more than 98% of the "incurable" problems submitted to our technical staff have been solved. John Crane recommendations, based upon scientific analysis and procedure are offered without obligation.

CRANE PACKING COMPANY, CHICAGO, U S A
CRANE PACKING COMPANY, LIMITED, HAMILTON, ONTARIO, CANADA

THE FLEX-DISC CLUTCHES

used in the new I-R *Mobil-Air* Compressors require so little attention that no time need be taken out for clutch maintenance. In the first place, the *Flex-Disc* is a spring loaded clutch and does not require adjustment to maintain clutch pressure.

Second; when the friction facings wear down to the point where the throw-out thrust collar is riding the clutch the operator can make adjustment in a few seconds without stopping the compressor. A turn or two with a wrench on the easily accessible pivot stud nut indicated below backs off the collar so it no longer rides the clutch while the compressor is running.



The throw-out thrust collar has *normally no* running contact when compressor is operating.

This pivot stud nut gives quick, non-critical adjustment of the throw-out collar.

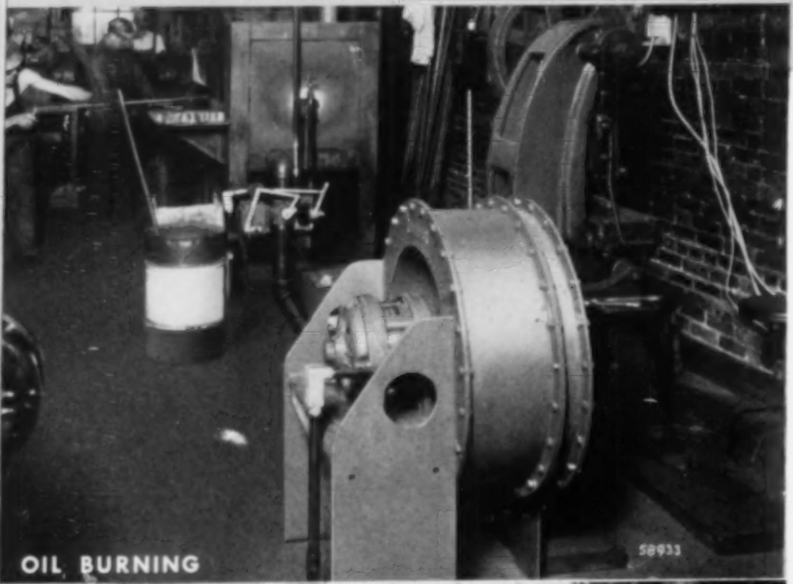
INDUSTRIAL CLUTCH COMPANY

Waukesha Wisconsin

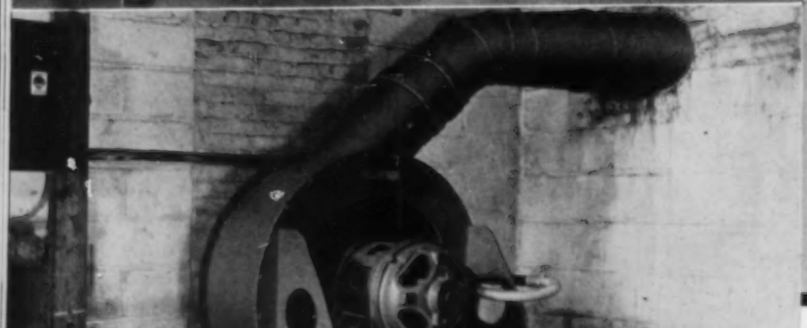
For Combustion Air

USE A

Type "G" MOTORBLOWER


OIL BURNING

GAS BURNING


BLOWING A SMALL CUPOLA

Since their introduction, Ingersoll-Rand's new low-cost Type "G" Motorblowers have been put to work supplying combustion air for a wide variety of heating jobs.

This sturdy unit is ideal for the purpose. It is compact, operates quietly and efficiently, and its pressure-volume characteristics are particularly suitable for such service. Despite its modest price, the Type "G" is an Ingersoll-Rand product through and through. You can count on it for long, trouble-free operation.

Type "G" Motorblowers are built in 72 sizes. Pressures range from ½ to 2¼ lb., and volumes from 100 to 4500 cfm.

A New BLOWER for OIL BURNING
Type "G" MotorBlower
Ingersoll-Rand

WRITE NOW *for* BULLETIN No. 2626

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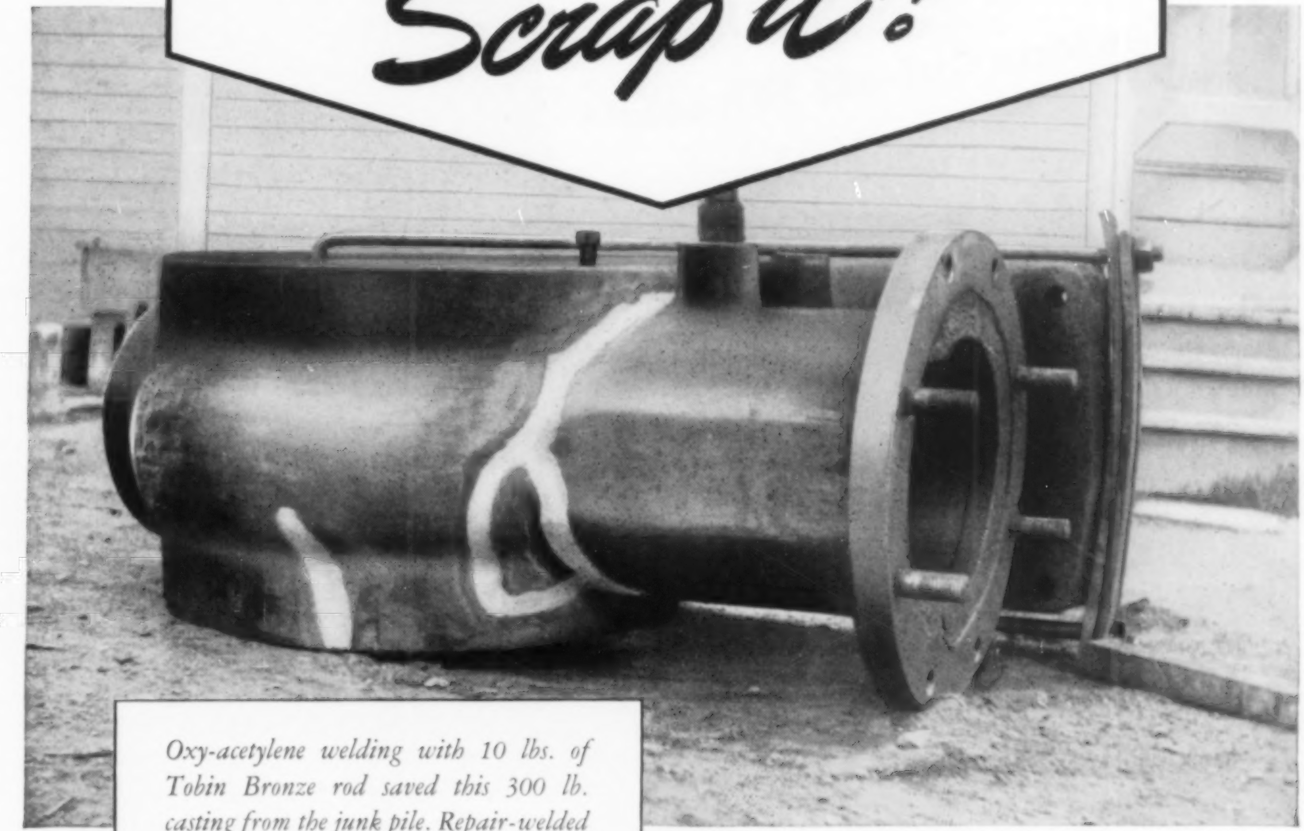
12-19

IN 1936—SOMEBODY SAID "*Scrap it!*"



Oxy-acetylene welding with 10 lbs. of Tobin Bronze rod saved this 300 lb. casting from the junk pile. Repair-welded by Gemme Garage, St. Damase, Quebec.

But it was repair-welded with Tobin Bronze. Still going strong in December 1940!

When cracks appeared in the base of this crude-oil engine block, attempts to prevent their extension by clamps proved futile. In a short time they had practically encircled the cylinder—only fifteen inches of solid metal remaining between the ends of the cracks.

Replacement meant heavy cost and important time lost waiting for the new casting. It was then that Tobin Bronze welding was suggested. And just ten hours later, the engine base was ready to go back into service.

Every day similar cases demonstrate that expensive equipment, seemingly damaged beyond repair, can often be salvaged at nominal cost by welding with Tobin Bronze—a time-tried Anaconda product. The trademark "Tobin Bronze Reg. U. S. Pat. Off." is stamped in every rod. Look for it and be sure you get the genuine.

41133-A

ANACONDA
from mine to consumer

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • Subsidiary of Anaconda Copper Mining Company

"60% Better Than Previous Cut-off Wheels"

Says Brass Foundry

THAT'S the production figures on a Norton rubber bonded cut-off wheel (16/6-U6R) in a Texas brass foundry as compared to the competitive wheel originally used. And in countless other non-ferrous foundries the Norton improved rubber wheel is showing similar economies for cutting gates and risers.

It's a wheel that was developed by Norton research especially for this work. In both abrasive and bond it was engineered for its job. The result is a wheel that combines fast cutting action with economical life.

In these times, when production is paramount, you'll find a Norton wheel on an efficient cut-off machine the fastest way to remove gates and risers from brass, bronze, copper, aluminum, monel metal and similar castings.

Let a Norton engineer give you the benefit of his experience.

Norton Company, Worcester, Mass.

W-795

RUBBER
SHELLAC
RESINOID

NORTON ABRASIVES

ON THE COVER

OUR cover picture is an after-dark view of Shasta Dam taken from the east abutment. Under brilliant floodlights, work goes on throughout the night at this site on the Sacramento River near Redding, Calif., where the U.S. Bureau of Reclamation is rearing the second largest concrete structure ever to be built. A part of the Central Valley Project, the dam will be 560 feet high, 3,500 feet long at the crest, and will taper in thickness from 580 feet at the base to 37 feet at the top. It will contain 5,800,000 cubic yards of concrete.

●

IN THIS ISSUE

MOST of us think of the semiarid regions of the West in connection with irrigation. Yet, in point of volume of water used per acre of crop, there is nothing there that can compare with the few rice-growing areas we have in this country. Approximately half the water has to be pumped, and the business of supplying it is largely conducted by private companies. The operations of one of them is described in our first article. Although rice is a nutritious and palatable food, it is for some reason not highly popular in the United States, the annual per capita consumption being only 6 pounds. The average Texan eats 10 pounds yearly, and growers are soon to launch an advertising campaign to increase the national consumption to the level prevailing in the Lone Star State.

●

AS OUR second article points out, talc has manifold uses, being incorporated in products ranging from face powder to cement. High-grade talc, suitable for cosmetics, now comes largely from India, where seemingly inexhaustible deposits exist in pockets located a short distance below the surface. Old and new methods of mining them are described by the manager of the principal operations.

●

COAL, especially industrial coal, is no longer bought on a hit-or-miss basis. Buyers are discriminating, and they demand a product that meets their respective specifications. Even the average householder is loath to wield an axe or a pick in his basement to size his coal, and he insists on a free-burning product with more heat and less ash per ton. These consumer trends, plus competition from other fuels, have caused coal producers to introduce scientific methods of treatment to assure their customers uniform, properly sized coal for various uses. In other words, they have added manufacturing to mining. Coal washing is a vital part of the treatment, and is done at many collieries with equipment that utilizes compressed air. Details are presented in the article starting on page 6460.

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Rice

C. H. Vivian

Photos from Ward Jacox, Beaumont

RICE UNDER CULTIVATION AND MILLING DIAGRAM

These pictures show a field of young rice soon after irrigation was started (center), when the grain was nearing maturity (top), and during harvesting. In the Beaumont area rice is ordinarily planted with a 16-hole drill drawn by a tractor. From 110 to 120 pounds of seed is sown per acre and from 30 to 40 acres can be planted in a day. After being cut, the grain is shocked for ten days and then threshed, unless weather conditions are unfavorable. A threshing crew may be composed of as many as 32 men, and a 30-inch cylinder thresher can turn out 800 sacks of rough rice daily. On the opposite page is a diagram of the process of milling rice, showing samples of the various intermediate and final products. It is published by courtesy of H. T. McGill, Stuttgart, Ark.

RICE is a rather unimportant item in the diet of the average American, but it is the principal energy food of more than half the population of the globe. The annual per capita consumption in the continental United States is only 6 pounds, as compared with 100 pounds in Cuba, more than 200 pounds in India, Korea, French Indo-China, Java, and the Philippine Islands, and from 300 to 400 pounds in Japan, Formosa, and Thailand. Figures for China are not obtainable; but rice is the chief food of a large percentage of her people.

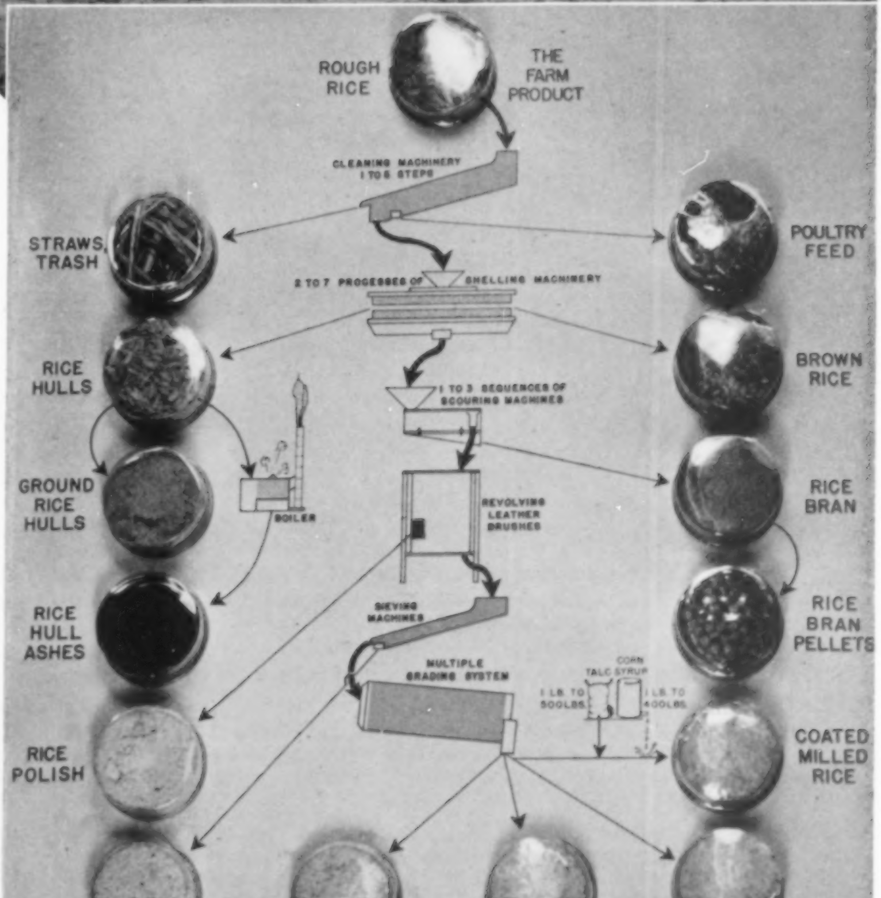
Asia grows approximately 97 per cent of the world's rice crop, with the remaining 3 per cent divided principally among Italy, Spain, Brazil, Egypt, and the United States. Our country's share of the total is about 1 per cent. This represents some 50,000,000 bushels, which is more than we consume, leaving an exportable surplus. Europe formerly took from us as much as 200,000,000 pounds annually; but last year the war reduced this to around 5,000,000 pounds. Cuba and Puerto Rico are now our only large customers.

There is evidence that rice was cultivated in the Orient as long ago as 3,000 B.C. somewhere in the area between southern India and Cochin-China, whence it gradually spread westward and northward. It was introduced in the Colony of South Carolina at or near Charleston about 1685, the first seeds probably having come from Madagascar. It became a popular crop in South Carolina, as well as in North Carolina and Georgia, and as late as 1859 those three states produced 90 per cent of the country's total, some of which was exported to Europe. The Civil War, with its resultant shortage of capital and labor, made rice-raising in the South Atlantic States unprofitable, and the acreage given over to it there decreased rapidly. This was offset by an increase in acreage in Louisiana, where the cultivation of the cereal received a real impetus in 1887 when it was determined that it could be profitably grown by the use of machinery. Two years later Louisiana became the leading rice-producing state, and it still holds that position. The principal growing area in Louisiana is the prairie region in the southwestern part of the state adjacent to the Gulf of Mexico.

In 1899, rice cultivation was started in the vicinity of Beaumont, Tex., and was gradually extended southwestward along the coastal plain. In Arkansas it was first grown in 1902 in what is known as the Grand Prairie section and has since become an important crop there. California began raising it in 1912, and the area around Biggs in the Sacramento Valley is

now largely devoted to its production. All told, approximately 1,000,000 acres are planted to rice annually in these four leading states. The 1940 yield was more than 52,000,000 bushels, of which Louisiana contributed 34 per cent, Texas 30 per cent, Arkansas 19 per cent, and California 17 per cent.

Satisfactory rice culture demands warm weather during the growing season, comparatively level land with soil that will hold moisture well, good surface drainage, and a plentiful and dependable supply of fresh water for irrigation. These conditions prevail in the areas just mentioned; and in many of the counties or parishes within them the principal cash crop is rice. The land is prepared by plowing, disking, and harrowing, plowing often being done in the autumn so that the soil can mellow during the winter. The preparatory work involves the construction of earth levees to hold the irrigating water. These not only surround the main field, but also divide it into smaller tracts, the number of which depends upon the size of the field and the slope of the ground. The levees have gently sloping sides over which farm machinery can readily pass, and are high enough to impound water to a depth of from 4 to 6 inches. Ordinarily they are sown to rice, not so much for the yield but to keep down weeds the seeds from which would blow into the fields and grow there.


ROUGH RICE
THE FARM PRODUCT
CLEANING MACHINERY 1 TO 5 STEPS
STRAWS, TRASH
POULTRY FEED
2 TO 7 PROCESSES OF SHELLING MACHINERY
RICE HULLS
BROWN RICE
1 TO 3 SEQUENCES OF SCOURING MACHINES
GROUND RICE HULLS
BOILER
RICE BRAN
REVOLVING LEATHER BRUSHES
RICE HULL ASHES
SIEVING MACHINES
RICE BRAN PELLETS
MULTIPLE GRADING SYSTEM
TALC
CORN SYRUP
1 LB. TO 500LBS.
1 LB. TO 400LBS.
RICE POLISH
COATED MILLED RICE
BREWERS RICE
RICE SCREENINGS
RICE 2ND. HEADS
UNCOATED MILLED RICE

Irrigating water normally is delivered to the highest side of a field and passes successively to the lower subfields through openings in the levees, which are closed when the desired depth is attained.

Seed rice is planted from 1 to 2 inches deep. Drills are usually used in Louisiana and Texas, while in Arkansas much of the grain is broadcast by end-gate seeders. Sowing by means of airplanes is practiced to some extent in California, the seed being fed from a hopper into the air current of the propeller. Guided by flagmen on the ground, the pilots fly back and forth until they have covered a field. Then they repeat the maneuver, flying at right angles to the first sowing. In the southern states, planting is generally done between April 1 and May 15, but it may take place in March if weather conditions are favorable. The time depends somewhat on the kind of seed—that is, on how long it will take to mature, and this may range from 120 to 189 days. The duration of the growing season is influenced both by the variety of rice sown and by the time of planting. In general, all kinds require a longer growing season and produce a higher yield when sown early than when sown late. Rice is planted in the unmilled state, with the hulls on the kernels. Care is taken to sow only a single variety in a field and also to remove weed seeds, hulls, and trash before planting.

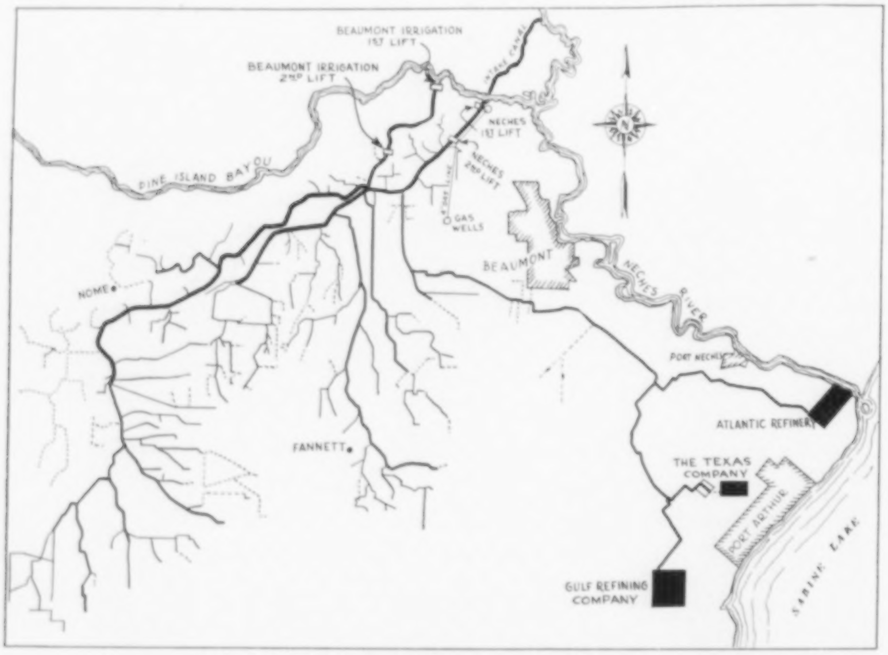
If sown in moist ground, seeds will ordinarily germinate without irrigation; but water is turned into the fields if required. In that event, the land is drained promptly to prevent rotting of the seed. Usually, the first irrigation takes place when the plants have reached a height of 6 to 8 inches, at which time the surface is covered to a depth of 1 to 2 inches. As they become taller, the depth of water is increased to 4 or 6 inches, and is thereafter held at approximately 5 inches until the end of the growing season. The land is then drained, a separate series of ditches being provided for that purpose. After about two weeks, during which time the ripening process continues, the ground is dry enough to bring in tractor-drawn machinery for harvesting and threshing. The rice is ordinarily harvested with a binder, shocked for ten days for drying, and then threshed.

In Arkansas, from 24 to 30 inches of water is needed to produce a crop of rice, and of this about 6 inches is normally contributed by rainfall during the growing period. The remainder is obtained chiefly by pumping from wells owned for the most part by the individual farmers. On the coastal plains of Louisiana and Texas, the seasonal water requirement is approximately 48 inches, of which 20 inches is ordinarily supplied by rainfall. Of the deficiency, from 30 to 40 per cent in Louisiana and from 15 to 20 per cent in Texas can be met by pumping from wells. The remainder is taken from the rivers and bayous, being elevated by pumps and distributed over the fields by canals. These pumping and distribution systems are usually operated by private companies, which charge the farmers so much per acre irrigated. They are classed as public utilities, and their rates are determined by state agencies.

One of the leading concerns of this type is the Texas Public Service Company which operates in the Beaumont area where rice was first grown in the state. Its holdings are, in fact, made up of the two original irrigation systems that were established there. The oldest of these was the Beaumont Irrigating Company which was founded in 1899 and acquired by the Texas Public Service Company in 1929. The other was started as the Treadway System, became the Neches Irrigation Company in 1901, and was taken over by the present operators in 1928. The two systems supply water to an area measuring roughly 44x25 miles and lying principally in Jefferson County, with the lesser acreage in Chambers and Liberty counties. Distribution is made through 300 miles of canals and laterals.

The region served varies from year to year, but ranges between 43,000 and 47,000 acres, including 3,000 acres of rice land that the company owns. It farms approximately one-third of this with its own forces and rents the remainder to tenants. Two independent concerns have pumping plants that take water from the canals and elevate it to distribution systems at higher levels, one of them handling as much as 10,000 gpm. In addition to serving the rice farmers, the Texas Public Service Company supplies water to the municipalities of Port Neches, Grove, and Port Arthur and to three petroleum refineries—the Gulf Oil Corporation, The Texas Corporation, and The Atlantic Refining Company—at the last-named place.

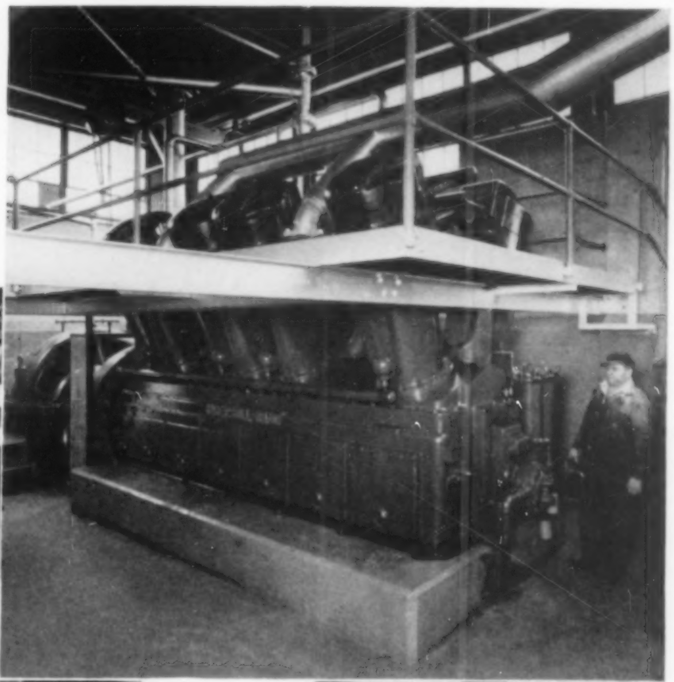
As an accompanying map shows, the Neches canal system takes water from the Neches River some 8 miles north of Beaumont, while the Beaumont Irrigation system taps the Pine Island Bayou which joins with the Neches at a point about 4 miles north of Beaumont. In both cases, the water is elevated to the canals in two lifts. There are, accordingly, two pumping stations for each system, or four in all. The Neches first-lift station raises the water 34 feet and the second-lift station elevates it an additional 9 feet. Corresponding figures for the two stations of the B. I. system, as it is usually referred to, are 31 and 10 feet, respectively. The main canals of the two systems cross at a point approximately 6 miles from the

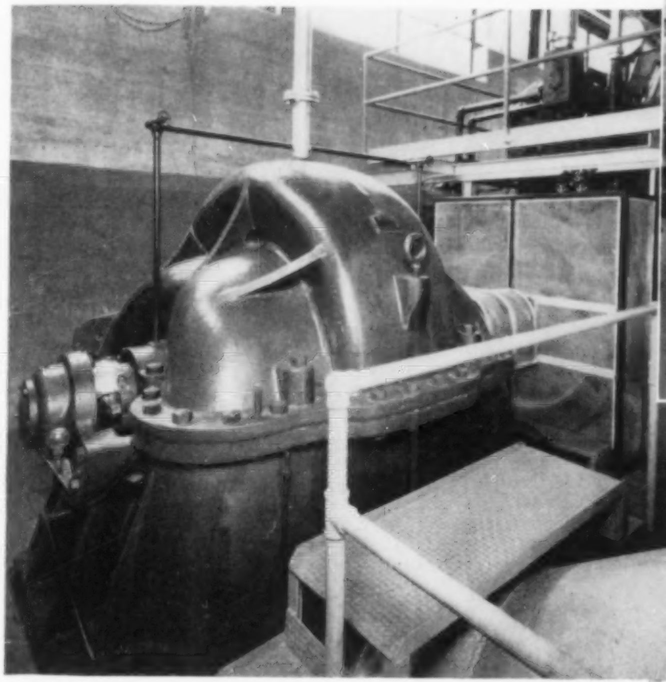


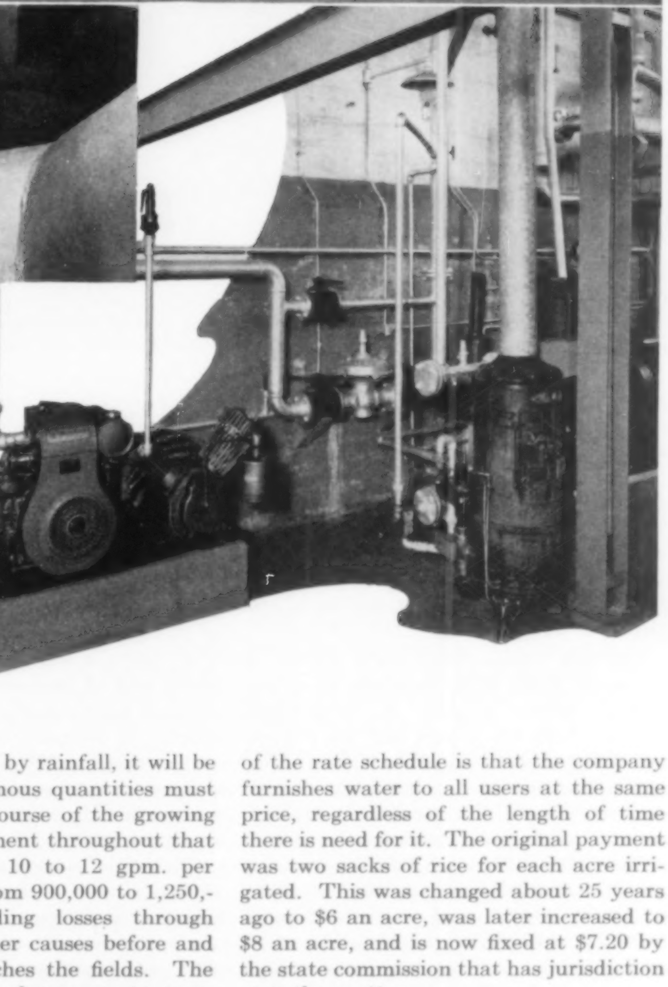
MAP OF CANAL SYSTEM

The Neches and B.I. irrigation systems comprise about 300 miles of canals ranging in width from 200 feet down to 16 feet. The intake canal of the Neches system conveys the water by gravity flow 4½ miles to the first-lift pumping plant, passing underneath Pine Island Bayou in three 8-foot pipes. Water from the B.I. system is taken directly from the bayou. In dry years, temporary dams are erected below the intakes to prevent salt water, carried up from the Gulf of Mexico by tides, from getting into the canals. In addition to supplying water for irrigating more than 40,000 acres of land, the canals furnish on an average more than 10,000,000 gallons daily to three municipalities, including Port Arthur, and to three large oil refineries near that city, this water flowing a maximum distance of 27 miles from the intake. The municipal supplies and the refinery water used for boiler feed are chemically treated. Natural gas for boiler fuel in the pumping plants and for the two gas-engine-driven pumping units in the Neches system stations is piped from the nearby West Beaumont Field.

All photographs following are from Joe Litterst, Houston, Tex.







NECHES FIRST-LIFT PUMPING UNIT

At the top, right, is shown an 8-cylinder, 650-hp. PLVG gas engine driving a 50,000-gpm. pump that raises water a vertical distance of 34 feet from the intake to a canal that carries it to the second-lift pumping plant. The equipment was made by Ingersoll-Rand Company and was put in service in July, 1939. Above is a view of the unit from the pump end. The pump discharge is 36 inches in diameter. The engine is started with high-pressure air supplied by the Type 30 compressor at the extreme left in the picture at the right. After being set in motion with gasoline, the engine driving the compressor operates on natural gas. The stovelike object in the right foreground is a gas-fired coil-type heater that serves to keep the gas-engine circulating water at the correct temperature during nonoperating periods so that the engine can be started and placed under full load without delay whenever desired. Beyond the heater is a Nash Hytor rotary vacuum pump used for priming the large pump.

intake of the B. I. system. The Neches canal is about 3 feet higher than that of the B. I. and is carried over the latter in a flume. This difference in elevation makes it possible to feed water by gravity from the Neches into the B. I. system when that is desirable. The main canal of the Neches system is 200 feet wide and 4 feet deep: that of the B. I. is also 200 feet wide but only 3 feet deep. Distribution laterals and their branches range in width from 100 feet down to 16 feet. A maintenance crew of 25 men is employed for cleaning out and repairing the canals.

Bearing in mind that about 48 inches of water is needed in this section to raise a crop of rice, and that only 20 inches of it is normally supplied by rainfall, it will be apparent that enormous quantities must be pumped in the course of the growing season. The requirement throughout that season ranges from 10 to 12 gpm. per acre, or a total of from 900,000 to 1,250,000 gallons, including losses through evaporation and other causes before and after the water reaches the fields. The amount is increasing from year to year, because more and more rice planters are sowing a long-grain variety that has a longer growing period (180 days) than those that have previously been raised. The irrigation season formerly extended from April 1 to September 1, but now it continues until October 1. A peculiarity of the rate schedule is that the company furnishes water to all users at the same price, regardless of the length of time there is need for it. The original payment was two sacks of rice for each acre irrigated. This was changed about 25 years ago to $6 an acre, was later increased to $8 an acre, and is now fixed at $7.20 by the state commission that has jurisdiction over the matter.

To supply the essential water, the company has sufficient pumping capacity to lift 440,000 gpm. into the canals. Of this, 260,000 gpm. is on the Neches system and 180,000 gpm. on the B. I. system. As the water is lifted twice, each of the two stations of the respective systems has the

EXTERIOR OF PUMPING PLANT

The picture at the right shows the pond at the Neches first-lift station and the pipe through which it discharges into the canal that starts at the top of the hill at the left. This end of the building houses the gas-engine-driven pumping unit illustrated on the preceding page. Below is a view of the plant from above, with a section of the canal in the foreground.

same capacity. Except for one modern unit in each of the Neches plants, the pumping equipment originally installed in the four stations is still functioning. It consists of steam-driven pumps of various types, the drivers being reciprocating engines in all but one case where a turbine is in use. The pumps range in individual capacities from 25,000 to 70,000 gpm.

The new units, which were placed in service in June, 1939, are made up of gas engines direct coupled to centrifugal pumps. Both the pumps and the drivers are of Ingersoll-Rand manufacture. The installation in the first-lift station consists of a Type PLVG, 8-cylinder, 650-hp., 4-cycle gas engine driving, through a Falk coupling, a Class AFV 36-inch pump rated at 50,000 gpm. against a head of 36.5 feet. Engine and pump operate at 300 rpm. The PLVG, which is also built in a 6-cylinder, 485-hp. size, is a V-type machine with separately cast cylinders each 14½ inches in diameter and having an 18-inch stroke. It was developed primarily for oil-field service, either as a prime mover or, more often, in combination with direct-connected horizontal compression cylinders. When so arranged, this compressor unit is known as the LVG, and its design follows in general that of the smaller Ingersoll-Rand Type XVG gas-engine-driven compressors of which more than 200,000 hp. have been sold.

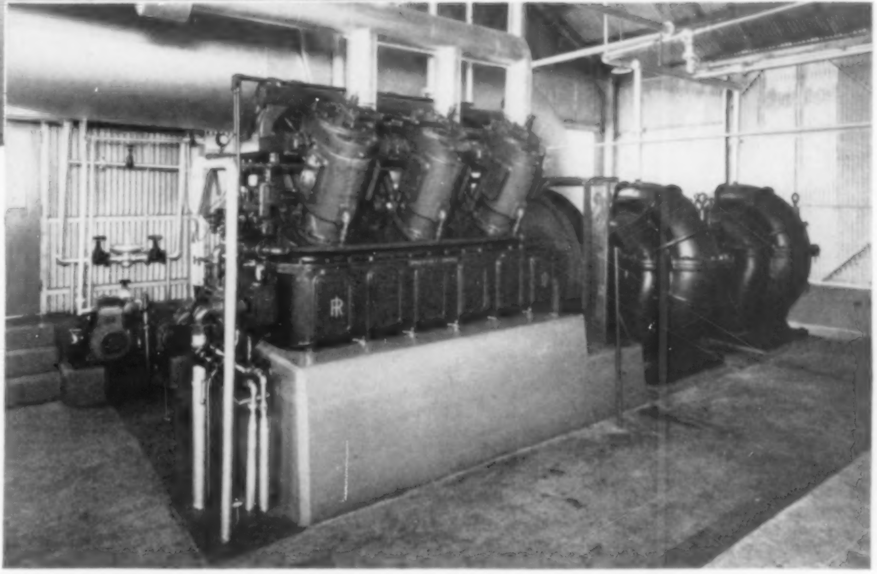
The unit in the second-lift station is made up of a Type PVG 6-cylinder gas engine direct coupled to two Class CFV 30-inch centrifugal pumps arranged in parallel. Each pump has a rated capacity of 25,000 gpm. against 11 feet of head. The engine is essentially the same as the power end of one size of the XVG compressors mentioned in the preceding paragraph. It normally operates at 400 rpm. and is rated at 275 hp.; but to meet the present service requirements its speed has been reduced to 280 rpm., at which it develops 192 hp.

The two pumping units have satisfactorily and economically solved the company's problem of winter pumping. As was previously stated, the rice irrigation season extends from April 1 to October 1, and in that period all the equipment in all four stations is operated wellnigh continuously. During the remainder of the year the demand is limited to supplying water to the three municipalities and the three refineries already referred to. The requirement is about 75,000,000 gallons a week, the refineries alone using a minimum of 8,500,000 gallons daily. As this is furnished entirely by the Neches Canal system it is unnecessary to operate any part of the B. I. system during the nonirrigation season.

This wintertime demand is now met by running the gas-engine-driven units in the two Neches Canal system stations for about seven hours three days a week, or each a total of from 21 to 22 hours weekly. Such intermittent operation can be handled very economically with this type of equipment, whereas with the older steam-driven units it was necessary to fire boilers, especially for this rather restricted service, and the resultant costs were high. The new units also have the advantage of being able to start pumping almost instantaneously whenever water is needed. In order to facilitate this, both engine rooms have been provided with gas-fired coils that keep the lubricating oil and the circulating cooling water at the correct temperatures for efficient full-load operation.

Both of the engines are conservatively rated for continuous full-load service and are equipped with various automatic devices to protect them from possible damage and to reduce attendance to a minimum. They have full force-feed lubrication, the oil being forced through a filter, a tubular-type cooler, and thence to the main bearings by a spiral-gear pump that is driven directly from the crankshaft. Before starting, the oil pressure is built up to the proper point by a hand-operated pump. Short-circuiting switches stop the engines in case of overspeeding, when the circulating-water supply fails or becomes too hot, and when the lubricating-oil pressure is not maintained.

As one of the accompanying illustrations shows, the gas-engine pumping unit at the Neches first-lift station is set up in a room with a concrete floor and high concrete walls. This was constructed at one end of the building housing the older



NECHES SECOND-LIFT PLANT AND NEW PUMPING UNIT

At the left is a picture taken from a highway bridge and looking up a canal to the pumping station that supplies it with water. The canal is 200 feet wide and is carrying 4 feet of water. Below is a view inside the plant showing a PVG, 6-cylinder, 192-hp. gas engine driving two 25,000-gpm. pumps arranged in parallel. At the left is a Type 30 compressor that furnishes air for starting the engine.

steam-driven pumping equipment, but its floor level is some 3 feet lower than that of the remainder of the structure. The entrance to this room is closed by a sliding steel door that can be barricaded and made watertight by means of a rubber gasket. The reason for thus enclosing the equipment is that high water is occasionally experienced in the winter season. This was true last winter, when the engine and pump operated regularly despite the fact that the water level outside was 7 feet higher than the floor on which they stand. Access to the room was gained during that period by scaling a wall.

Rice culture in the Beaumont area has undergone great improvement in the comparatively brief span that it has been practiced there. The yield per acre has been increased from about ten barrels to fourteen or fifteen. This has been brought about by the use of better seed, by improved farming methods, and by adequate drainage of the land when it is not under cultivation. Sixteen kinds of rice are raised in the United States, but only four or five of them are planted extensively in this section. In general, the cereal may be divided into short-grain, medium-grain, and long-grain rice, the mature plants of which range from 36 to 58 inches in height. The average length of the hulled kernels of these varieties is, respectively, 0.21 inch, 0.26 inch, and from 0.27 to 0.31 inch. The short-grain rices produce good yields and are of good milling quality and for that reason predominated during the early period of the industry in this country. Gradually, however, the medium and long-grain types came to be preferred by the consuming public, and the farmers began to shift to them. In the Beaumont district, Early Prolific, a medium-grain rice, was grown by most farmers until a few years ago. Now the trend is towards Rexora or Patna, a long-grain variety.

Research has improved the yield of long-grain rices and also developed better milling methods which have overcome the previous reluctance of farmers to plant them. Formerly, the long, narrow grains were more susceptible to breakage in milling than the shorter grains of larger girth; and as only whole grains can be marketed for first-grade table rice the result was reduced returns which made them unpopular with farmers and millers alike. Now, however, there are ways of overcoming this breakage; and, with the long-grain varieties commanding the highest prices, farmers are turning to them more and more. Patna rice stands the weather well when it has to be left in the fields a considerable time before threshing. Ordinarily this is done promptly, but exceptionally rainy weather in the Beaumont area during the past winter postponed the threshing season to February for the first time in fifteen years. Fortunately, a goodly percentage of the crop was Patna, and comparatively little of it was hurt.

As the rice comes from the thresher, each kernel is enclosed in a hull or husk and is known as rough rice. Although some of it is fed to livestock, most of it is sold to millers, who prepare it for the market. A barrel of rough rice weighs 162 pounds and, when milled, yields approximately 104 pounds of whole and broken kernels, 31 pounds of hulls, 21 pounds of bran, and 6 pounds of polish. After being screened and fanned to get rid of trash, chaff, weed seeds, lumps of dried mud, and light seeds, the rough rice is passed between milling stones which remove most of the hulls. The mixture of hulled rice, rough rice, and hulls is then separated by screening and fanning and treatment in what are called paddy machines. The rough rice is returned to the milling stones. The hulled kernels, encased in a layer of gluten (bran) and designated as brown rice, next go to hullers where a percentage of the bran and most of the germ are removed by friction. After the bran has been separated by screening, the grain passes through a second set of hullers and sometimes also through a pearling cone. Rice in this form is more nutritious than when further refined, but the American public for some reason insists that the cereal be a lustrous white, and it is therefore given further treatment. This is done in a polishing machine known as a brush, where remaining traces of bran and several layers of starch cells are rubbed off. These finely divided materials are called rice polish. The polished grains are steamed and sometimes also receive a

B.I. PUMPING PLANT AND FLUME

In this station, which takes water from Pine Island Bayou, there are only steam-driven pumps some of which have been in service since 1899. The water is lifted 31 feet and flows through the wood flume to a second plant, where it is elevated an additional 10 feet. The flume is 6 feet high and 15 feet wide.

coating of glucose and talc to improve their appearance. The grain is then separated into grades, weighed, and bagged for the trade.

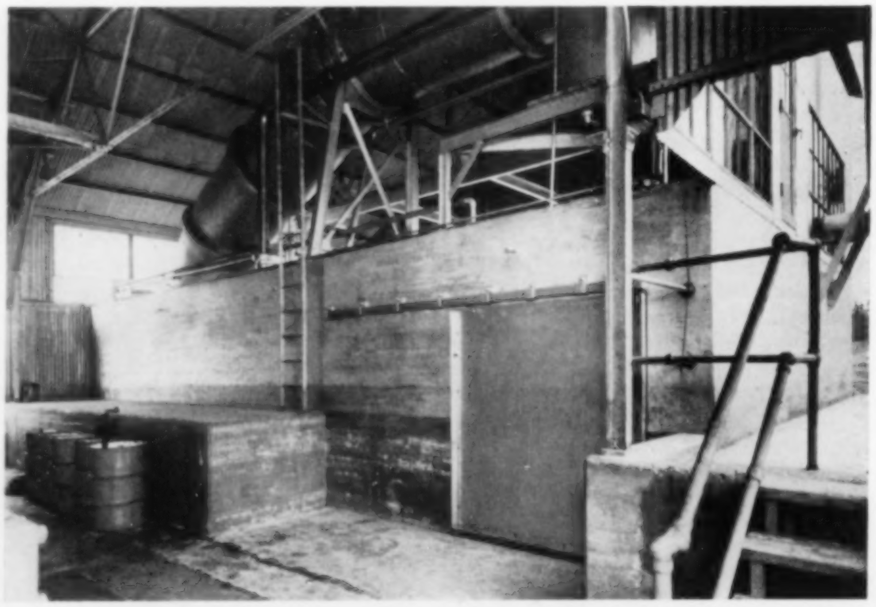
The unbroken kernels, known as whole or head rice, are sold under several grades based chiefly on color, luster, and size. Most rice is consumed in this form, but some of it is converted into puffed or flaked cereal, or into flour. Broken kernels are sold as "second heads," screenings, and brewer's rice and serve as food, feed for livestock, in making beer and ale, and as a source of starch and flour. The starch is used in laundries and in making cosmetics, confectionery, adhesives, vinegar, acetone, and alcohol. Bran and polish produce concentrated livestock feed, and polish is employed as a thickening for gravies, etc., as a stuffing material for sausages, and in the manufacture of buttons, soap, and oil. Rice hulls are utilized as fuel, packing material, insulation, fertilizer, and as a source of cellulose for making paper products and plastics. Rice straw serves as stock feed, fuel, fertilizer, and as a material for making mats, hats, brooms, rope, paper, and cardboard.

The American Rice Growers Coöperative Association, whose president, Capt. A. H. Boyt, resides in Beaumont, is a leading force in assisting rice farmers with their problems and in promoting their interests. It has warehouses at various points in the rice-growing regions where planters may store their crops pending their sale to millers; and it provides facilities for grading the grain, fumigating it to eradicate weevils, and for otherwise rendering essential services to its owners. The Beaumont warehouse has room for storing 80,000 bags of rough rice. Millers' representatives visit these warehouses, sample the bags by gouging metallic instruments called "triers" into them, and make their bids for the grain on the basis of the samples.

The association is endeavoring to improve the quality of the rice offered the consuming public and is sponsoring local radio programs advocating its use. Some dealers, to add to their profit, mix two or more kinds, adding less expensive short-grain and medium-grain rice to the top-price long-grain varieties. As the different kinds have varying cooking characteristics, some requiring longer periods than others, this tends to lessen the palatableness of the dish that reaches the table and, consequently, to prejudice the American public against the cereal. To overcome this, the association is putting out long-grain Patna rice under its brand name and making it known in various ways.

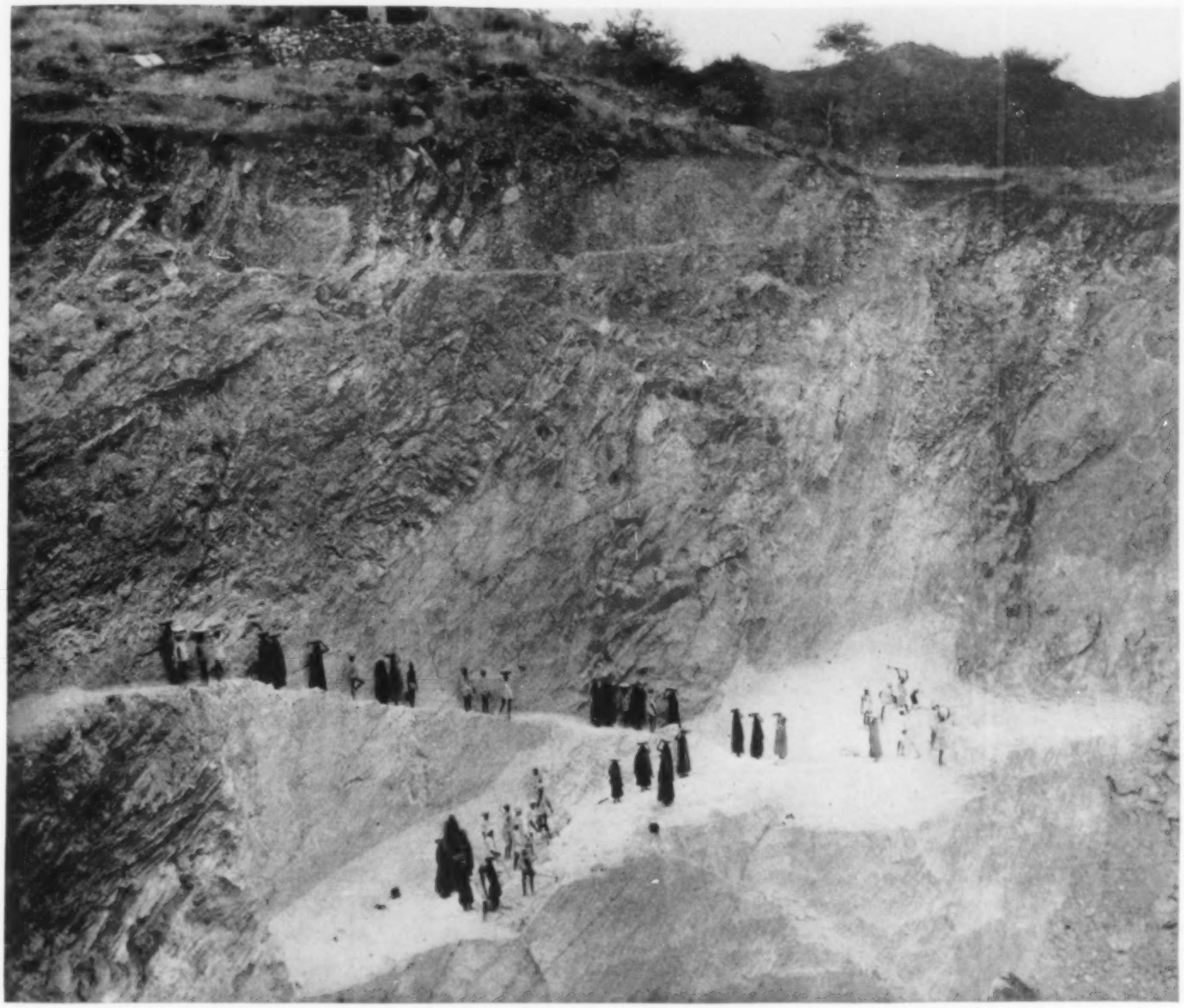
With an eye to popularizing rice through national advertising, the association last winter advocated a rice tax of two cents per 100 pounds payable by the miller. A bill to that end was introduced in the legislatures of Arkansas, Louisiana, and Texas and carried the proviso that it must be passed by all three states to make it effective. Arkansas and Louisiana lawmakers quickly approved the measure, and it was passed by the Texas legislature in May. The law is to be in force two years, and will raise approximately $200,000 annually. With this fund the association will endeavor to make the American public rice conscious, just as Florida and California have promoted the welfare of the citrus-fruit industry and Wisconsin has extolled its cheese and other dairy products. The average Texan now eats 10 pounds of rice a year, which is 4 pounds more than the per capita consumption in the country as a whole. The aim is to bring the latter up to the Texas figure.

One reason that most Americans eat so little rice is attributed by the authorities to the failure of many housewives to cook it properly. For one thing, they say that rice should never be stirred when boiled but should be lifted from time to time with a fork. Stirring tends to make a gummy mass of the cereal, whereas the individual grains will keep their identity if properly treated. As a contribution towards better rice, the association not only offers recipes but also a meshed-wire cooker for boiling it so that it will always be light, white, and flaky.



WATERTIGHT ENGINE ROOM

The gas-engine-driven pumping unit in the Neches first-lift plant is inclosed in a room of concrete having a steel door that can be made watertight with a gasket. This precaution was taken to protect the machinery and also to keep it from being drowned out during high-water periods. During the past winter the water was up to the first rung of the ladder at the left-center, the mark being still visible on the wall. It was 7 feet higher than the floor of the walled engine room. During the flood the engine was operated as usual three days a week. Overhead is shown the discharge pipe rising from the pump. It is 5 feet in diameter.



OLD WORKING METHOD

A deposit of talc, showing native men mining the mineral with picks and coolie women carrying it to the surface in baskets borne on their heads. These methods are giving way to mechanical aids, as illustrated on the next page.

Something About Talc

R. Crawford Lees, M. I. M. E., C. B. T. E., M. E. A.*

THE United States produces essentially all the low-grade talc it requires; but, as the accompanying article relates, fine-quality talc for use in cosmetics is imported. Until recently the principal source of supply was Italy. Since 1935 the higher-grade product of India has come into our markets. It sells at from $45 to $80 a ton wholesale.

It is significant to note that, despite the low cost of native labor, machinery has replaced hand methods in mining the Indian talc deposits. As the author points out, when the pits go beyond a certain depth it is less expensive to drill, transport, and pump by mechanical means than by manual operations. The experience of the Jaipur Mineral Development Syndicate will no doubt be watched with interest by numerous producers of other minerals in India who are still working open pits largely with hand labor.

AT DAGOTHA, a village 16 miles north of Dausa in Jaipur State, India, the Jaipur Mineral Development Syndicate is working a deposit of talc and transporting it to its mill at Dausa where the mineral is prepared for marketing. Much of this talc reaches the public in the form of talcum powder and other cosmetics, but there are many other applications for the three grades produced there. The operations at Dagotha are of especial interest because modern machinery has replaced hand labor in the mining operations.

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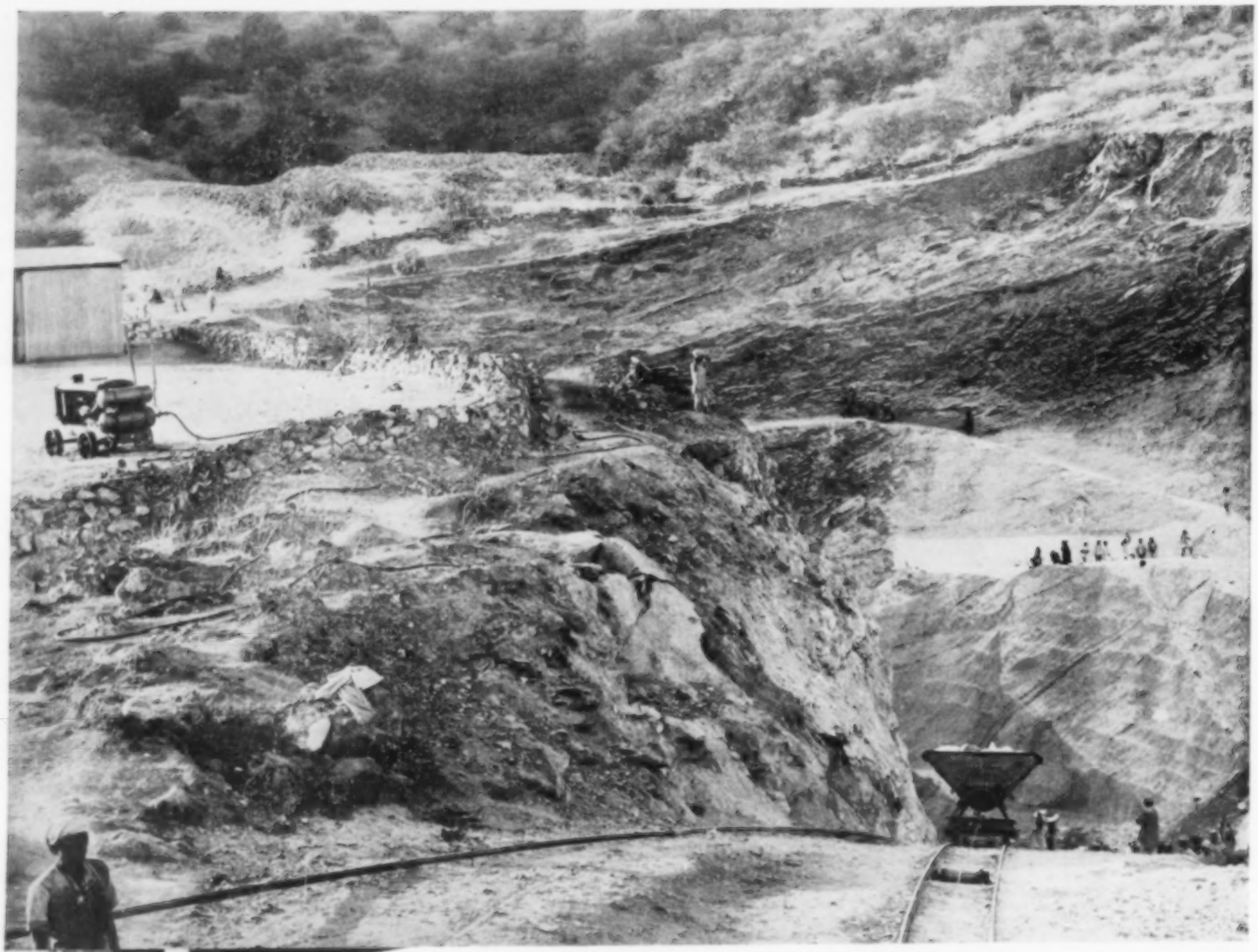
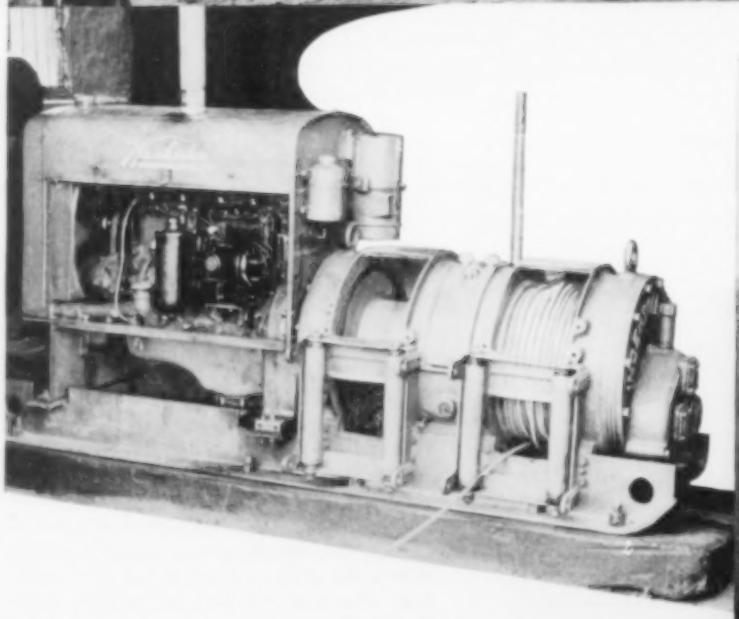
*Manager, Jaipur Mineral Development Syndicate





MODERN EQUIPMENT

View of a talc pit (top) with one of the cars (right foreground) that are now utilized to haul the mineral to the surface. On the level area at the left is an Ingersoll-Rand portable compressor that furnishes operating air for the Jackhamer drills that have replaced hand drilling. The picture above shows the hoist that pulls the cars from the pit. The drum on which there is no rope will later be used for auxiliary service. At the right is a Calyx core drill that is employed in prospecting for pockets of talc.

CONTRASTS IN HAULAGE

Until recently the crude talc was transported from the Dagotha mines to the mill at Dausa in bullock-drawn carts. As a part of the recent mechanization program, trucks have been adopted for that service. At the left in the picture below R. Crawford Lees, manager of the Jaipur Mineral Development Syndicate and author of this article, is shown with N.K. Vakharia, managing director of the syndicate.

Talc is a hydrous silicate of magnesia which, in its compact and somewhat impure forms is called steatite or soapstone. Iron and aluminum are generally found among the impurities. It was known to ancient peoples, with whom it was a favorite material for carving because of its softness; and it is used for the same purpose today by the Chinese. Owing to the ease with which it can be worked and its resistance to ordinary heat, it has been used at various times for making pots and, accordingly, bears the name of potstone in some places.

Dagotha talc exists in foliated and compact masses. Its hardness is 1.2 in the mineral scale, and its specific gravity is 2.7. It varies in color from white to pale green, and has a nacreous or pearly luster. It has good colloidal qualities. A chemical analysis of a typical Jaipur talc is: Silica, 61.8 per cent; magnesium, 31.4 per cent; aluminum, 0.8 per cent; iron (as ferrous oxide), 0.7 per cent; water of hydration and traces of alkalies, etc., 5.3 per cent; lime, negligible. The following general information about talc and the geological occurrence of the Dagotha deposits was furnished by Dr. W. Chowdhry, Ph. D., M.M.G.I., F.G.S., of Paris:

"Talc is a widely distributed mineral in India, but at most places it is of inferior quality. It is the practice in that country to classify soapstone deposits with talc deposits. This is not correct, because talc is a definite mineral, whereas soapstone is a rock containing talc and other minerals. Jaipur State is the largest producer of talc in India. The most important deposits are those at Dagotha, which are now being operated by the Jaipur Mineral Development Syndicate. The mineral occurs there in large pockets in limestone belonging to the Rialo series of rocks of pre-Cambrian age. The Rialo limestone is a dolomite containing more than 42 per cent of magnesium carbonate. The talc has been derived from the dolomite by metamorphic processes resulting in the conversion of magnesium carbonate into hydrous silicate. It is also likely that a part of the mineral has been derived from tremolite, which occurs in the neighborhood, by the action of water carrying carbon dioxide. These original constituents are found as nodules in the talc deposits."

The principal working at Dagotha is a huge pit measuring about 300x150 feet at the surface and gradually tapering to the bottom, which is now about 200 feet below ground level. It is estimated that 250,000 tons of talc remain there to be mined. Other deposits are being opened, and their resources are practically unlimited. Prospecting is done with Calyx core drills, a hole being put down wherever geological deduction indicates the existence of talc. The core obtained shows the presence or absence of the mineral and, if any exists, reveals the depth and thickness of the pocket. From this information it is determined whether or not it is of sufficient magnitude to justify commercial development. If it is decided to open it up, the overburden is cleared away until the top of the deposit is exposed, and then the work of mining the talc and bringing it to the surface is started.

Until recently all these operations were done by hand. If there was any hard rock in the overburden it was manually drilled and blasted with explosives. The broken material was carried away in baskets, holding about 20 pounds each, on the heads of coolies. Labor is cheap, and these methods are practicable until a pit attains considerable depth. If the pocket continues downward, a point is finally reached where it can no longer be worked at a profit by manual labor alone.

This economic limit was reached in the case of the large pit at Dagotha, and machinery was called to the rescue. A portable air compressor and Jackhamers have replaced hand methods for drilling hard-rock overburden, hard nodules, and the talc itself. A hoist, track, and cars have been substituted for the slow and ultimately expensive procedure of transporting the material from the bottom of the pit to the surface on the heads of coolies traveling paths cut into the walls. A centrifugal pump driven by an electric motor is used to raise the water that collects in the pit. This, too, was formerly carried up by coolies. With the machinery now set up all the talc in the pocket can be mined and brought to the surface economically.

From the pit workings the talc is transported to the mill at Dausa in trucks, which have been in service only a short time. Previously all the material was hauled in carts drawn by bullocks. Upon delivery at the mill, it is first hand sorted, and the various grades are put in stock sheds. The talc is withdrawn from storage as required and pulverized by a 5-roller Raymond mill. Air currents are utilized in separating the product into the three sizes that are marketed: The coarsest, or Grade 3, is 100-mesh—that is, it passes through a 100-mesh screen—and 30 per cent of it will go through a 200-mesh screen. The intermediate size, Grade 2, is known as 200-mesh, but 97 per cent of it will pass through a 300-mesh screen. Grade 1 is 300 mesh, but some of it is even finer.

The powdered talc is packed in jute bags holding 100 pounds each. These are adequate for domestic consumption, but for shipment abroad another thinner bag of finely woven cotton material is added. The material is now ready for distribution to all parts of the world. Because of its softness, lightness, pleasing color, antiseptic qualities, imperviousness to air moisture, heat, and cold, and its colloidal qualities, it has manifold fields of application. The more important ones of each of the three grades produced are:

Grade One

Is principally used in making cosmetics such as creams, pastes, lotions, face and toilet powders, as well as foot powders. These require a talc that is free of grit, iron, and lime and that is white in color. The Dagotha talc answers these specifications admirably.

Grade Two

Serves as a filler for many grades of paper and as an ingredient in coating mixtures for glazed or coated stock. It is also employed in the paper industry for bleaching cellulose and for removing resin therefrom. For these purposes the talc should have a minimum lime content, be free of ferric salts, be white in color, and have good colloidal properties.

In the textile industry it is used variously in dressing, sizing, and bleaching cotton cloth; in drying, polishing, and sizing pile fabrics; and in dyeing. It likewise serves as a filler and duster in the manufacture of linoleum and oilcloth.

In the making of rubber it is utilized as a filler, for dusting molds during vulcanization, and as a protective coating for crude rubber.

Paint manufacturers use it as a filler and constituent in paints, as well as an absorption agent in pigments. It is especially suitable for enamels, for cold-water, waterproof, fire-resistant, and disinfectant paints, and for flexible roofing paints. Talc for these applications must have good colloidal qualities.

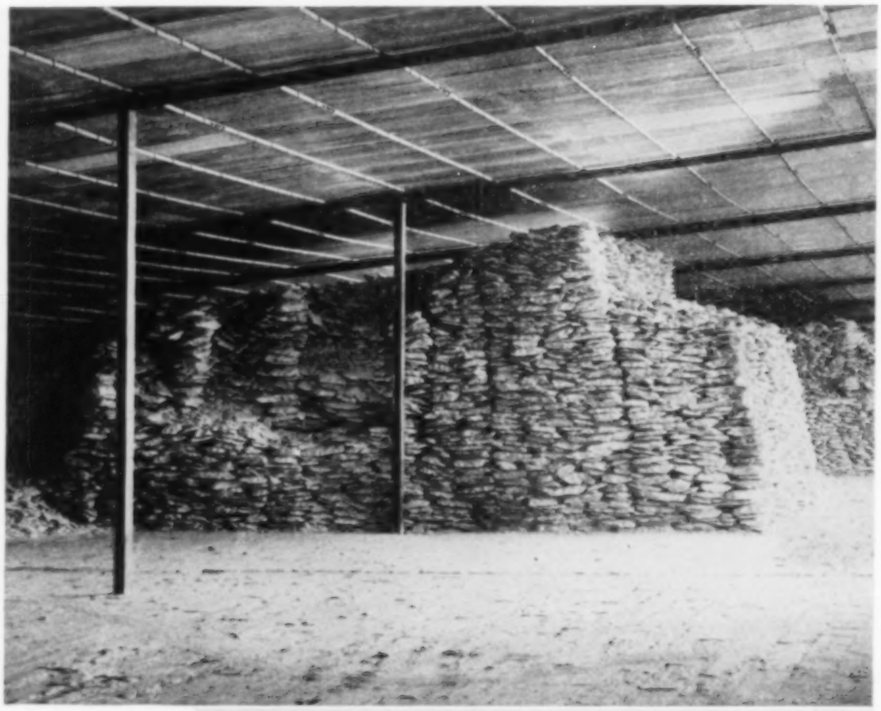
As a filler, it enters into soap-making. In India, where tallow and other animal fats are objectionable, talc takes the place of these ingredients.

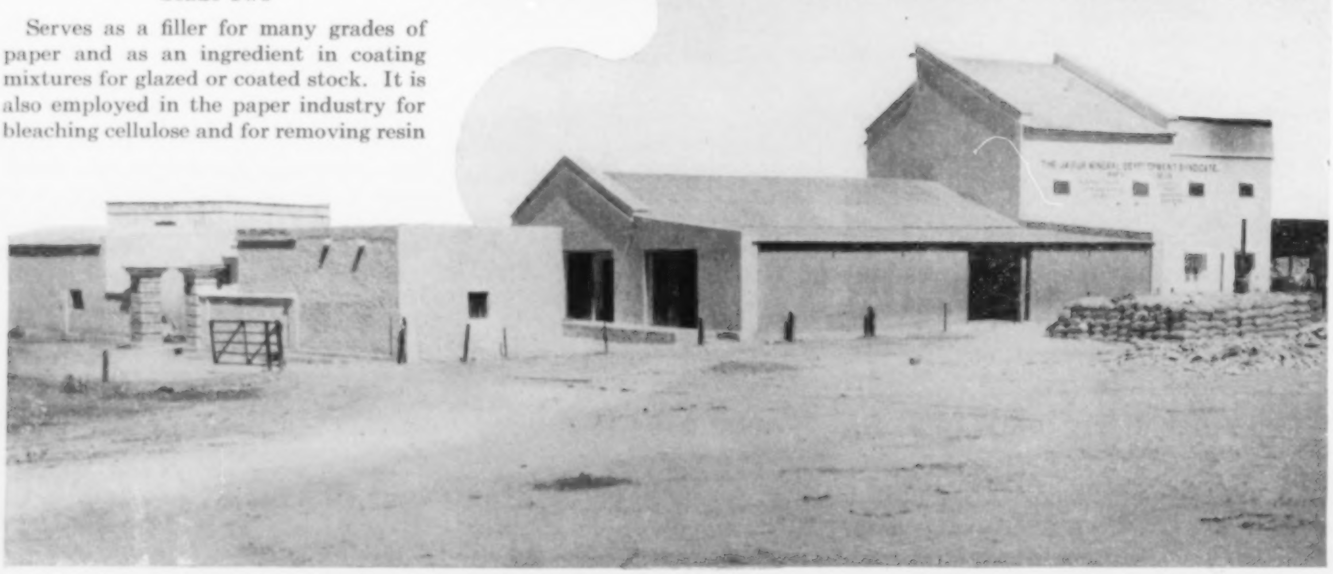
In foundries it is employed as a facing material for molds for which purpose it is often mixed with graphite. It is also used for dusting molds in the manufacture of cork and of glass. In the latter industry it serves as a polishing agent especially for plate glass.

In the food industry it is utilized as a

MILL AND CRUDE TALC

A general view of the mill buildings and warehouses at Dausa, and stocks of crude mineral stored there under cover awaiting processing.





cleaner, polisher, bleacher, and conserver of rice, peas, coffee, beans, maize, barley, peanuts, fruits, vegetables, and eggs.

It finds application in chemical and pharmaceutical establishments as a packing material for metallic sodium and potassium, for which purpose it is wetted with oil. In powder and tablet form, it serves as a contact material for catalysts.

Other uses of this grade of talc are: as a filler in making twine and rope, as a filtering medium in oil refining, as an absorbent for nitroglycerine, and for dusting wounds and sores and treating skin diseases of animals.

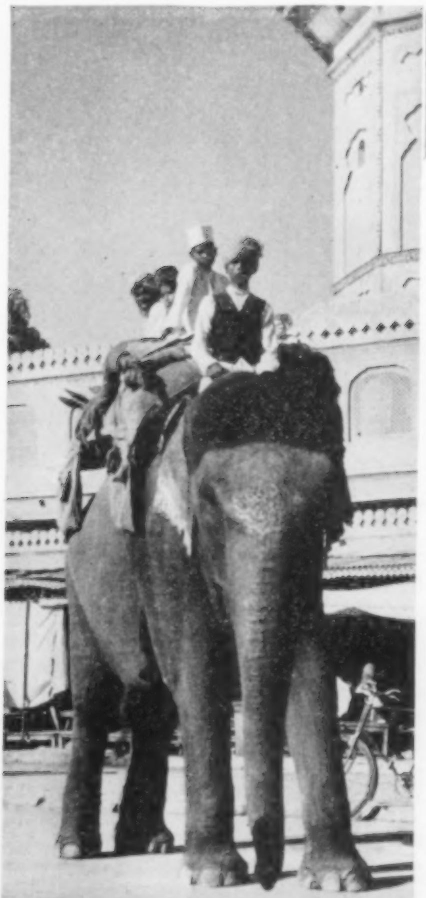
Grade Three

As a filler in roofing paper, which is also coated with it to prevent sticking.

In the leather industry it is utilized as a dressing for skins and leathers, for drying oily leather, as a substitute for wheat flour in making glacé kid, and as a powder for shoes and boots to give the wearer foot ease.

It is an ingredient in special cements, finishing plaster, composition flooring, and in asbestos shingles, blocks, and slabs. Of late, it has entered into the making of wall tile and other ceramic bodies.

BURDEN BEARERS
An elephant and a camel on a street in Jaipur and a *bhisti*, or water carrier, near the talc mines.



Stonework is often given a protective coating of 100-mesh talc; and, together with sodium silicate, it is employed for preserving, fireproofing, and acidproofing wood. It is also used as a preservative for cloth and for various food products such as coffee, rice, and barley.

In agriculture it serves as a filler in fertilizers, as a filler or extender for insecticides, and as an ingredient in remedies such as "Fastet," a mixture of copper sulphate and talc, for plant diseases.

In addition it is found in floor wax and in polishes for stoves, shells, etc. In combination with starch or some other medium it is a dusting agent that prevents candy from sticking in molds in the process of manufacture and that meets a need in chewing-gum making. In imitation amber it gives the cloudy effect; is an ingredient in putty; makes window-shade cloth opaque; enters into the production of insulating compounds for wire, piping, electric switchboards, etc., for which purpose it is mixed with clay.

Massive Talc

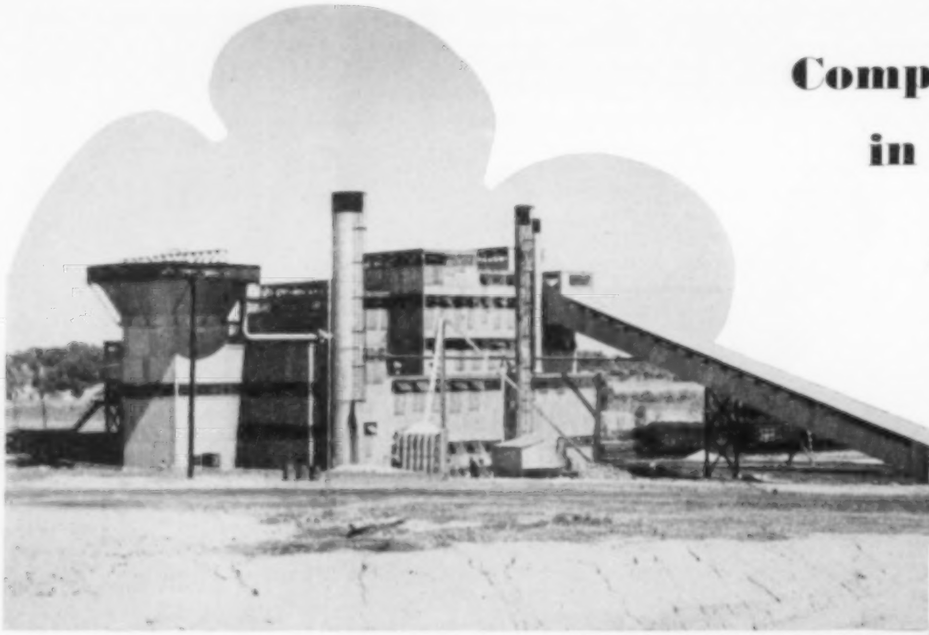
This product of the talc industry plays an important part in the field of electrical insulation, in gas-burner tips, and in spark plugs. For these services it must have a fine-grained structure, free of cracks and cleavage planes, be devoid of iron and grit, and be easily machinable. The compact, strong, and medium-hard grade is suitable for crayons and pencils, while the medium-soft variety is in demand for tailor's or French chalk. Molds in which bottles, watch crystals, and numerous other glass articles are formed are often made of talc, as well as molds in which iron, brass, copper and other metals are cast. In bricks or blocks it also serves the metallurgical industry as a refractory.

The United States produces around 200,000 tons of low-grade talc annually for industrial purposes. In addition, it imports about 50,000 tons of high-grade talc each year for cosmetics. Before the Jaipur source was available, most of the latter came from Italy and some lower-grade material has been imported from Japan.

The Jaipur Mineral Development Syndicate started operations at Dagotha in 1931, and the mill at Dausa went into service a year later. At first the products were supplied only to the Indian trade, but the market gradually expanded to include other parts of the British Empire. The first shipment to the United States was made in 1935. Since then, distribution has become world-wide. As import figures will bear out, cosmetic manufacturers the globe over have become aware of the excellent quality of talc from Jaipur State, India.

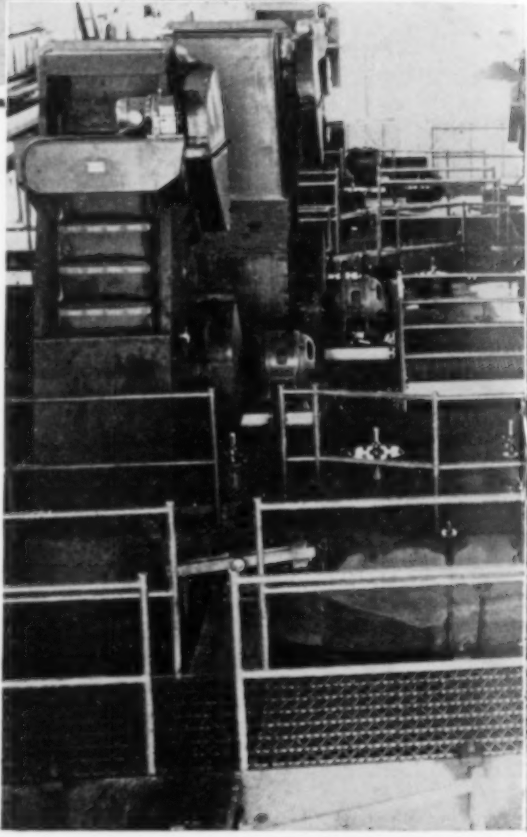
Compressed Air in Washing Coal

*C. H. J. Patterson**



TECUMSEH COAL CORPORATION

The modern plant shown above is at Dickeyville, Ind., and prepares 1,000 tons of coal an hour for the market. After the stripping operation the coal is hauled to the plant in 50-ton trailers, one of which is seen at the upper right dumping into the run-of-mine hopper. This is done without stopping the trailer, a tripping device at the hopper setting in motion the air-operated mechanism that opens the side gates. The coal is then conveyed into the plant, broken into pieces 6 inches or smaller, presized, and washed in four automatic washers. At the right is the assembly of pneumatic washers on the main washery floor.



AIR, covering a wide range of pressures, enters indispensably into many phases of the mining and preparation of ores and minerals. A particular application of compressed air in this field of service, and one that is rapidly increasing, is that of creating the surge or impulse in washeries especially for coal.

The basis of the separation of coal from the impurities that are mined with it is the difference in their specific gravities. As practically all the extraneous matter is heavier than the coal it will sink at a faster rate than the latter when placed in water. The washing of coal is desirable from the standpoint of the producer and the consumer alike. The producer has learned that washed coal sells more readily than coal not so treated, and commands a higher price. Even where there is not a big price differential, clean coal is in greater demand, and washing therefore tends to keep the mines in steady operation, thus reducing the overhead. The consumer's aim is to obtain as many net heat units as possible for his money. Washed coal contains less useless material to be paid for and to run up freight and handling charges. On the score of freight tariffs only, assuming an average rate of $2.25 a ton the country over, a saving of 1 per cent in ash content as the result of washing would reduce the total carrying charges on bituminous coal alone more than $12,000,000 annually. Washed fuel increases boiler efficiency and lessens sulphur corrosion, slagging, maintenance costs, boiler outages, and ash handling.

Insistence on washed coal is increasing all the while. Metallurgical plants, such as steel producers and manufacturers of gas, were the first to demand it. Next, public-utility companies began to specify it. Nowadays, most coal buyers, even for steam-producing plants, want clean, low-ash coal. Inasmuch as the rejection of marketable coal in the washing process is a direct loss to the producer, he wants equipment that will do an effective cleaning job at a cost commensurate with the returns arising therefrom. This, obviously, calls for automatic machinery of high selective capacity.

Because many of the impurities are attached to the coal and cannot be freed from it, a certain amount of coal is inevitably rejected with the refuse during the washing process. One of the problems is to determine how much of this coal is to be thrown away. Usually, it is decided to remove enough of the objectionable material to reduce the ash content of the finished product to a point where it will be acceptable to the consumer from the standpoints of appearance and performance.

"In so doing," to quote from a paper by Thomas C. Cheasley of the Hume-Sinclair Coal Company, "the losses of the mine-run feed usually range from 18 to 24 per cent, so it is readily seen that the problem here is to find and maintain the critical point at which the operation of washing turns from a satisfactory to an economically unsound procedure, because the changing of adjustments due to wear, or accident, could easily cause the rejection of a large amount of coal, without improving the shipped product.

"It would seem logical that the impurities or ash-forming materials might be removed on a uniform or increasing scale and thus gradually purify the remaining coal product; but, unfortunately, this is not true. There comes a point in the purification stage of nearly all coals where an abrupt change takes place. An ex-

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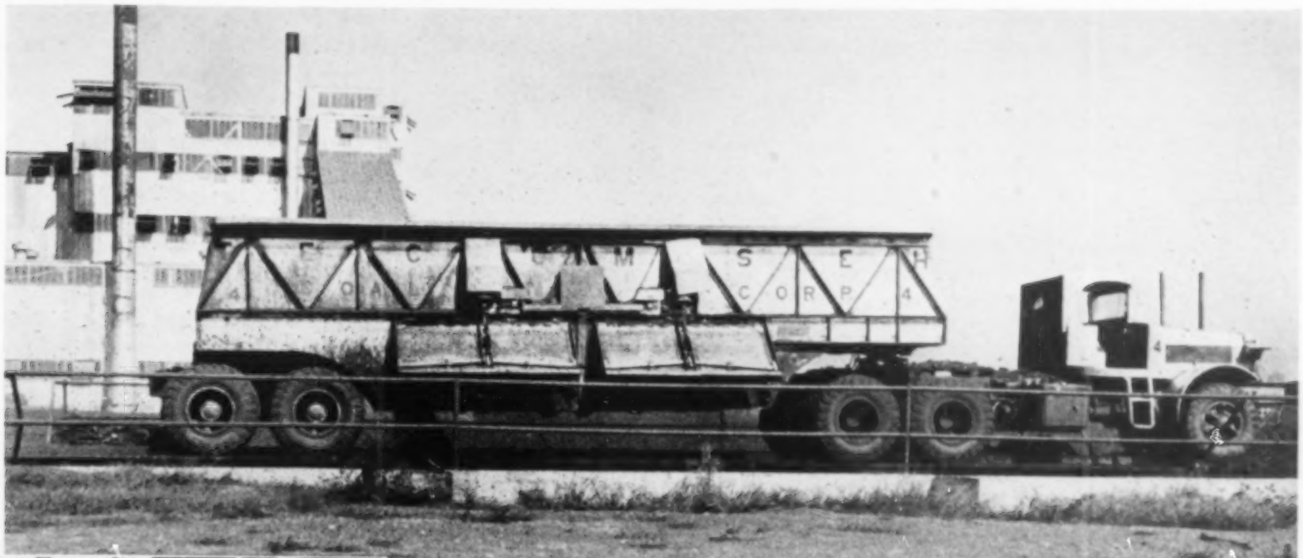
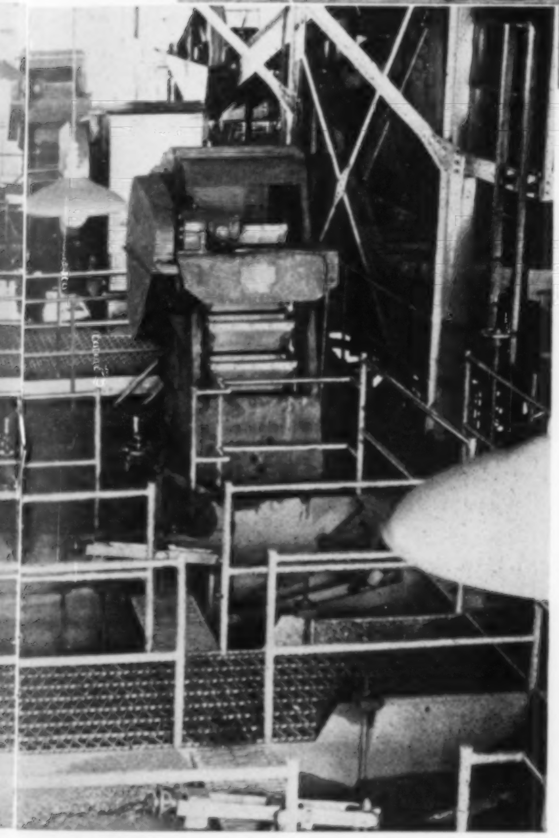
*Washery Engineer, The McNally-Pittsburg Manufacturing Corporation



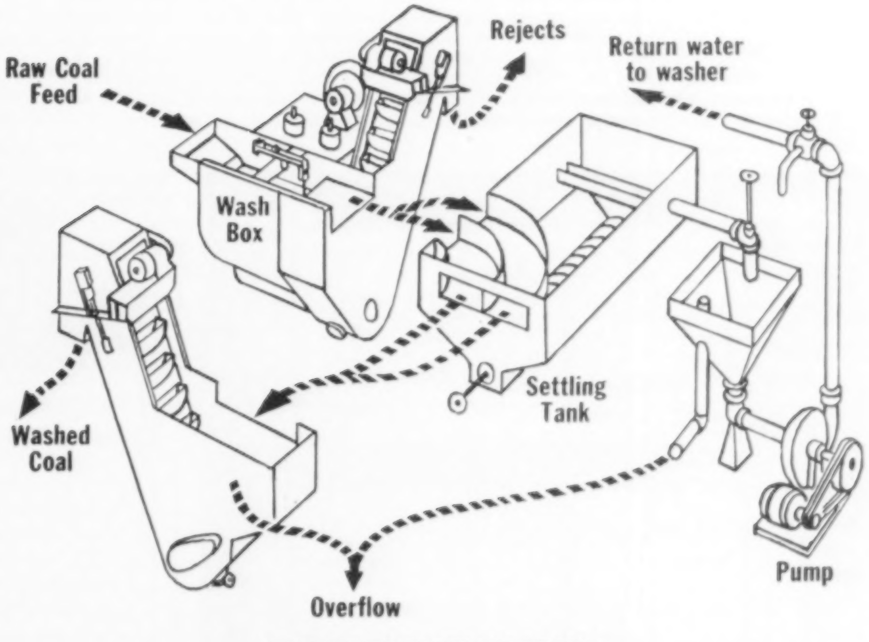


ample will clarify this. Assume that we have a raw coal containing 12 per cent ash-forming material. First, a washability curve is plotted from actual test, called sink and float test. Knowing something of the nature of the coal, we might use a test solution of 1.60 specific gravity and find, by immersing a test quantity of coal in the solution, that 95 per cent of the raw coal would float while the remainder, having an inherent specific gravity higher than 1.60, would sink.

"Samples of both the float and sink increments would be analyzed for ash and combustible contents. In the 5 per cent of the raw coal feed which sank, we might find that the ash content would analyze 90 per cent and the combustible wasted 10 per cent. The procedure would then be repeated, with a solution change in gravity of 0.05 at each step and with the weight and ash determinations checked at each test point. By the time we reach 1.50 specific gravity, we might find that our sink material runs 18 per cent by cumulative weight and we might have an ash content of 70 per cent and a combustible content of 30 per cent. The float material could have an ash content of perhaps 8 per cent.

"Now we are approaching the critical point, if we have not already reached it. When Southwestern coals are washed to deliver 9 per cent ash or less, they are usually considered satisfactory for all industrial or steam purposes. In fact, lots of chain-grate-stoker operators will not knowingly accept a coal with less than 9 per cent ash because they believe that much ash is necessary to shield their grates from high firebox temperatures.

"But there are many other types of stokers. While the ash content of a stoker coal is only a guide to the possible per-



SIMPLIFIED FLOW DIAGRAM

Layout of a washery equipped with a unit-type washer designed for cleaning from 25 to 75 tons per hour and for treating coal of nut, egg, stove, and stoker sizes. From the wash box, the rejects are elevated for disposal, while the coal goes to a settling tank and from there to an elevator for dewatering. Fine refuse in the water is allowed to settle before the latter is pumped from the sump for reuse.

formance of a coal in a given plant, nevertheless, in many stoker plants, the lower the ash content, the more acceptable the coal. The burning characteristics of any coal, however, mean much more than the spot at which a decimal point may be placed by a fuel chemist when running an ash analysis.

"However, to get back to the critical point, if with a 1.50 specific-gravity solution we found we had 18 per cent sink, or 82 per cent recovery of the raw-coal feed, and, for further purification, we used a gravity of 1.45 and found our sink percentage was 22 per cent and the resultant ash in the refined coal was 7.60 per cent, then we would have lost 4 per cent of the raw feed of coal to gain a reduction in ash of only 0.4 per cent. Unquestionably this would not be economical for mine operation, nor would the slight increase in purification be of any material benefit to a coal consumer. The adjustments on a modern wash box allow control of rejected material to a fraction of 1 per cent of ash, and thus, in production, the results of sink and float testing can be duplicated and maintained."

The use of water in separating minerals from their attendant impurities is far from new. Several types of washers are illustrated and described in Agricola's *De Re Metallica* (1556). A hand-operated lever jig was employed for washing coal as early as 1830 at a mine in Saxony, as reported in 1865. This unit was of the moving screen or basket type. The first application of a fixed screen jig seems to have been made in 1840 near Dresden.

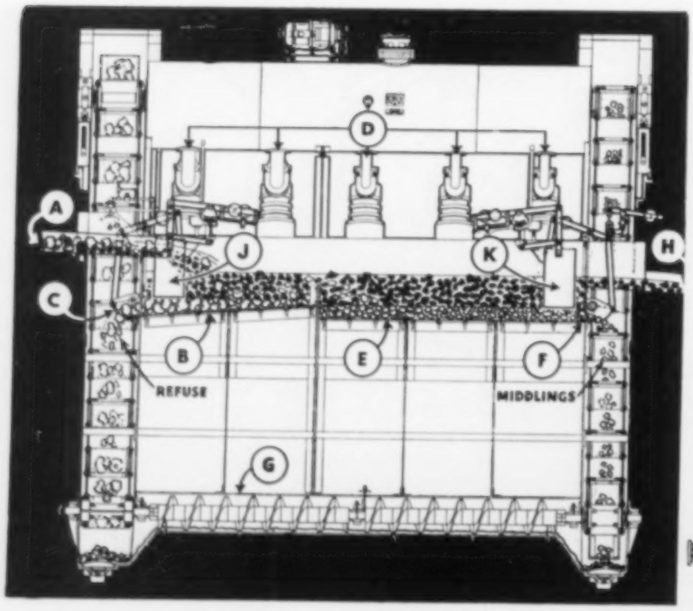
The washing of minerals is therefore not exactly a recent development, and even the use of compressed air dates farther back than many of us realize. The early machines were all designed for batch operation—individual charges were jigged until proper stratification was established and then unloaded by hand, the top and bottom strata being removed separately. About 1848 Berard introduced a continuous jig which soon replaced the intermittent or batch-type units. Continuous operation, however, set a definite limit to the number of pulsations to which the material could be subjected in passing through the machine, and it was soon found that only relatively close size ranges could be accurately stratified. It was probably about this time that Rittinger began his studies and experiments that culminated, in 1867, in the publishing of his findings and his formula for sinking velocities. This work still remains to a large extent the basis for such computations, although later investigators have developed more accurate values for the various coefficients. Because of Rittinger's work, close presizing became common practice in connection with mechanical cleaning.

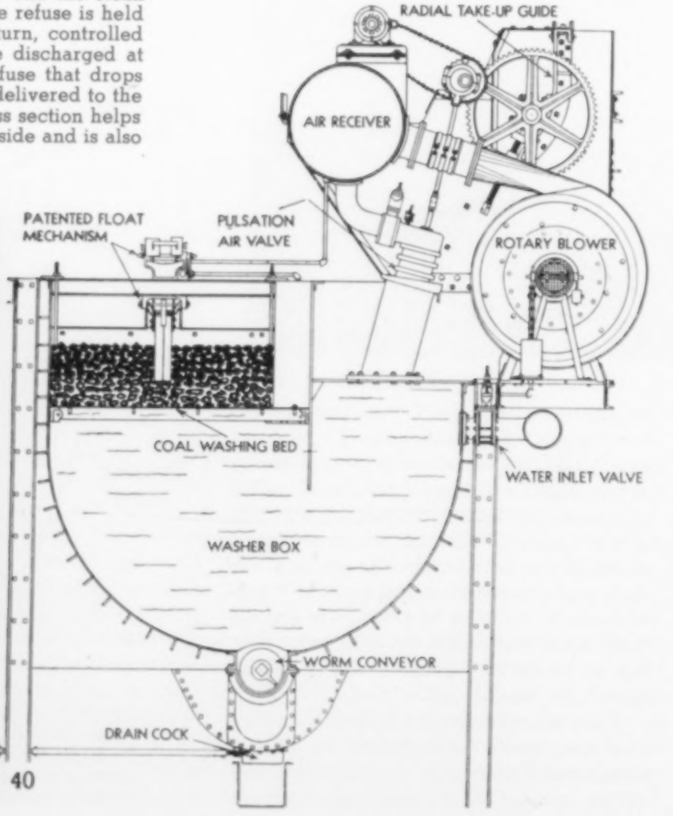
When solid particles sink freely from rest in a fluid, the individual particles begin to accelerate at rates directly proportional to their densimetric differentials above the solution density. As the velocities increase, however, sinking is retarded by hydraulic resistance, which is directly proportional to the transverse area of each particle and which increases approximately as the square of the sinking velocity. When the velocity is relatively high, the sinking rate is governed as much by the size and shape of the particle as by its density. Large, low-gravity particles may sink faster and farther than smaller or flatter particles of higher gravity. The separation is therefore not based truly on density unless the size range is very narrow or the density of the impurities differs greatly from that of the material to be recovered.

Theoretically, in jigging or impulse washing, the size range is not of paramount importance. If the entire mass of intermixed material can be lifted more or less bodily on the upward stroke, and then be allowed to sink in relatively still water, the initial sinking rate for each particle is governed primarily by its density, and the bed is so compacted that further sinking is prevented before the acceleration is sufficient to generate appreciable hydraulic resistance. The actual separation

HOW THE WASHER WORKS

Longitudinal (left) and cross sections showing the operating principles of the McNally-Pittsburg automatic coal washer. Incoming raw coal *A* is sluiced into the washer boxes by water. Air pulsations are transmitted through valves *D* to water in a compartment connected with the wash box and cause the water in the box to rise and fall at a controlled rate of from 30 to 50 times a minute. From the loosely suspended aggregate the heavier refuse is gradually separated and sinks to the screen plates *B*, while the lighter coal is moved by the action of the water toward the right and spills over into the second compartment. There the process is repeated, the remaining refuse sinking to the screen plates *E* and the clean coal passing on to the dewatering screens at *H*. The depth of the refuse is held constant by two refuse discharge gates *C* and *F* which are, in turn, controlled automatically by the counterpoised floats *J* and *K*. The refuse discharged at either end falls into wells and is elevated for disposal. Fine refuse that drops through the screens *B* and *E* at the bottom of the washer box is delivered to the wells at either end by the worm conveyor *G* in the base. The cross section helps to explain the operation. The air is introduced on the right-hand side and is also withdrawn there through suitable valving.





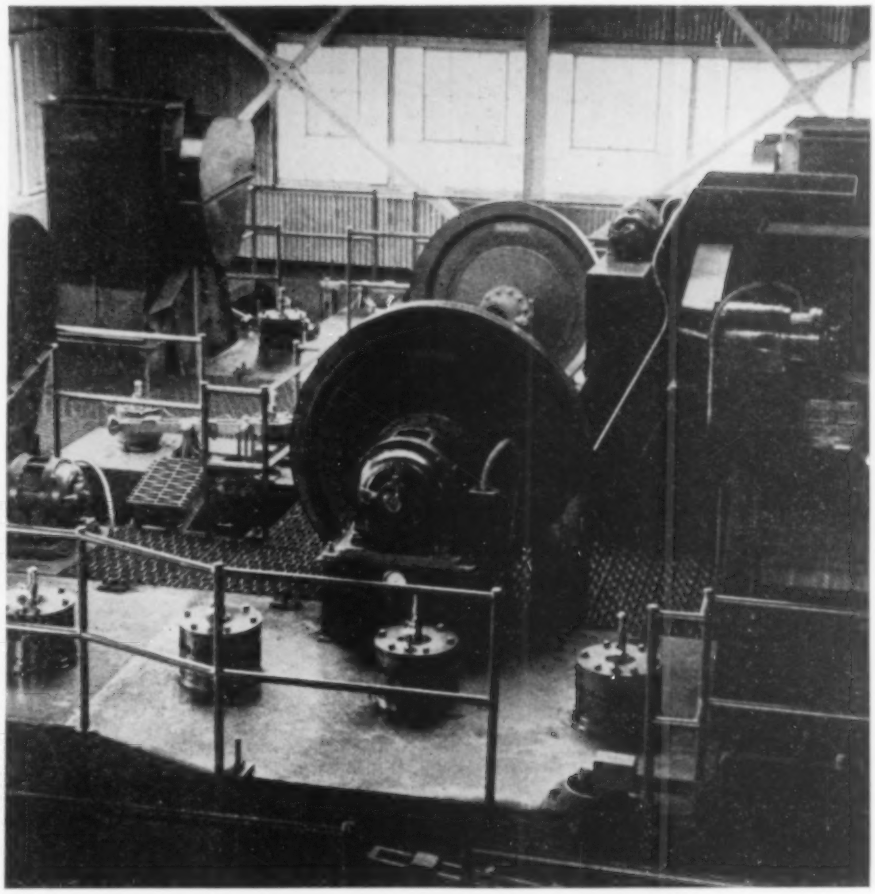
accomplished at each impulse or stroke is therefore definitely on the densimetric basis. No matter how small the actual separation between two particles of different density may be, it is multiplied with each successive stroke, and before the two particles have traversed the full length of the washer they should be sufficiently separated to be evacuated from different levels.

In the early washers, however, the impulses were produced mechanically either by jigging the material up and down in still water or by forcing water by mechanical plungers up through fixed screens which supported the material to be separated. Unfortunately, what goes up must come down, and thus the reverse stroke of the plungers or baskets was unavoidably accompanied by a reverse flow of water, constituting a so-called "back suction." The jigs became, in effect, merely current washers, the stratification being effected primarily by the relative velocity of the water and the solid particles. It was realized eventually that the theoretic conditions would obtain if the back suction could be eliminated, and many efforts were made along this line. These included various flaps and valves, and even covering the jig sieves with feldspar crystals which rose with the upflow but settled back into the screen perforations on the downflow. This method was used largely in the Luhrig jigs in treating fine coals.

Toward the end of the nineteenth century, Doctor Baum of Germany conceived the idea of inducing the washing impulse by the expansion of compressed air instead of by mechanical plungers or pistons. Admission of air could be closely and sensitively controlled and offered better regulation of the upward impulse. Moreover, because the air exhausted at the end of the impulse stroke could be replaced with water, back suction could be positively controlled. Baum's first machines of the single-cell type were put in operation in 1892. Several years later he developed his multiple-cell units, which laid the foundation for the washing of unsized feeds.

In 1903 the Baum process was introduced in Great Britain by Simon Carves, and after 1922 a number of other British firms adopted his principle for their washers. All adhered rather closely to the original Baum construction except Norton, who made several important improvements, including the automatic control of rejection, the nonclogging undercut ejection gate, and the open elevator wells. The first of these eliminated the human element from the control of the washed product; the second facilitated washing sizes larger than those previously handled; and the third, by making the entire screen area effective for washing, considerably increased the total treating capacity of individual units.

The first washers incorporating these features were built in Great Britain about 1927, and one was installed in the United States two or three years later. Meanwhile, the Simon Carves-Baum jig had made its appearance in this country, more than twenty years after its initial use in England, so that the original and the modernized Baum machines arrived here within a very few years of each other. Since that time Norton has made several additional improvements, the most important of which is the lowered air chest. This reduces the volume of air required for the washing pulsations and provides more nearly positive regulation of the impulse wave form and of the backflow.



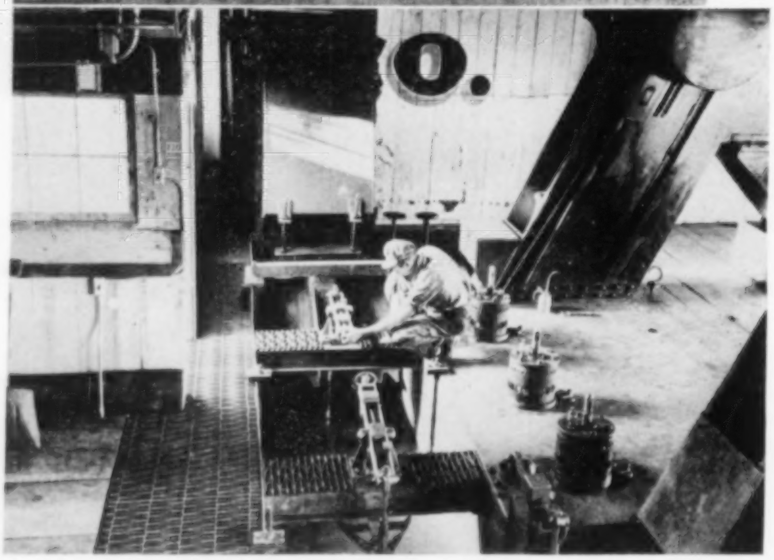
COMPOUND WASHING UNIT

This installation is at the No. 2 Mine of the Truax-Traer Coal Company, in southern Illinois, where the preparation plant can treat 600 tons of coal an hour. Shown here is a compound washing unit. The Ingersoll-Rand blowers that serve it are in the center. Blowers for coal-washing ordinarily discharge at from 2 to 3 pounds pressure and are made in a wide range of sizes up to a capacity of 9,500 cfm. As they can be arranged with the discharge openings in an endless variety of positions, they can be placed level with the top of a washer or on another floor.

More than 50 McNally-Norton coal washers now in operation in North and South America receive their air supply from Ingersoll-Rand turbine-type blowers. Units of the FS Type are employed for the standard machine, the construction of which is shown in an accompanying illustration. The air receiver is located beneath the operating floor and immediately above the air compartments of the several washing cells. Admission of air to and exhaust from the cells are controlled by sliding sleeve-type valves actuated by an eccentric shaft beneath the washer shell. The sleeves are adjustably positioned along the rods so that the relationship of the ports may be varied and the duration of the operating cycle divided accordingly between admission and exhaust. The rates at which the air and the water are admitted to each cell are regulated by additional valves. This combination of separate adjustments permits the impulse magnitude to be changed independently of the impulse intensity, or vice versa, providing an almost endless variety of impulse wave forms, as well as complete and precise control of the backflow.

The patented undercut evacuating gates also are pneumatically operated, taking their air supply from the receiver through patented relay valves which are positioned by the product control floats. By means of sliding counterpoises on calibrated beams, the floats may be set to ride at any desired densimetric stratum. Variations in the amount of coal delivered to the washer naturally tend to raise or to lower the concentrate bed. At the slightest departure from predetermined levels, however, the floats readjust the rates of delivery of air to the operating cylinders of the evacuating gates, expediting or re-

WASHED COAL BY
McNALLY-NORTON
COAL WASHER.
MARRIOTT-REED COAL CO.
PRODUCERS OF
Lindbergh Red Flame
COAL



MARRIOTT-REED COAL COMPANY

This company's strip mine near Columbia, Mo., has a daily capacity of 600 tons. Run-of-mine coal is hauled to the preparation plant in 6-ton trucks. It is crushed to 8 inches or under and screened to make four sizes. The two smallest, both under 3 inches, are washed in a McNally-Pittsburg 3-cell machine having a capacity of 50 tons an hour. A view of it from overhead, taken while it was not in operation, is shown at the left. The Type G Ingersoll-Rand Motorblower that supplies air for the washer is pictured above.

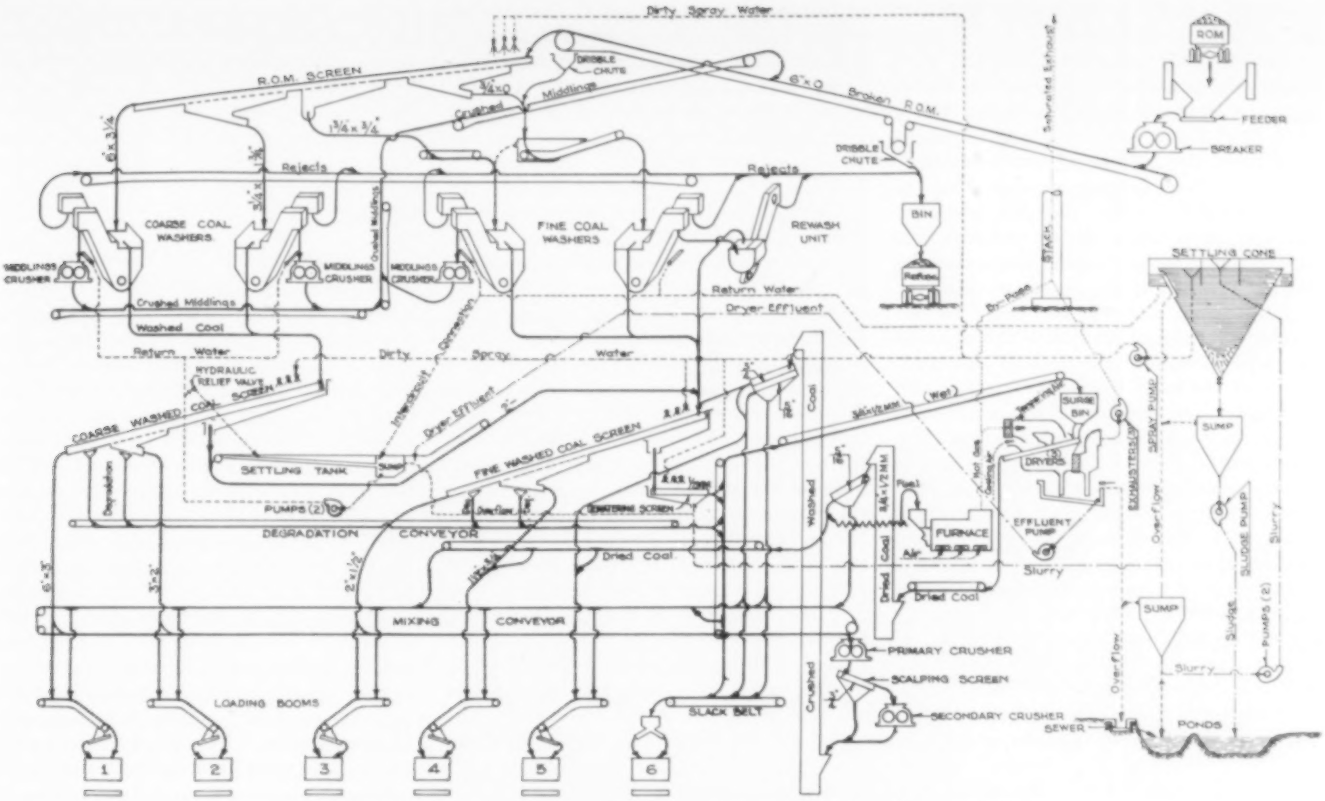
tarding the evacuation in conformity with the washing conditions and to maintain constant bed depths. The arrangement provides an infinitely wide range of evacuating rates—the rate being automatically checked and reset at intervals of not more than two seconds because the impulse frequency is usually between 30 and 50 cycles per minute. In the event delivery of coal to the washer should cease, the gates automatically close and discontinue evacuation until the supply is resumed.

Standard washers are available in five different sizes (widths) and with a wide variety of combinations of primary and secondary washing compartments with individual capacities from 40 to 400 tons per hour. These include the recently patented "compound" washer, a machine of any required size and cell arrangement with a built-in smaller rewash unit which receives the intermediate product or middlings, crushed or uncrushed, for retreatment.

There is a separate line of unit washeries for capacities under 100 tons per hour in which water clarification and recirculation, washed coal and refuse dewatering, and other auxiliary features are embodied. These use the Ingersoll-Rand "G" line blowers; and the washers incorporated in them are of the same general construction as the standard washers but do not deliver middlings as a separate product. They are furnished in two sizes (widths) and with two or three cells. The 2-cell or No. 1 Unit has a capacity of 25 to 40 tons an hour.

To illustrate the wide range of applications of coal washeries of this type, two representative plants installed last year will be described. One of these, operated by the Tecumseh Coal Corporation at Dickeyville, Ind., has a capacity of 1,000 tons of mine-run-coal feed per hour and loads numerous products and mixtures at six tracks. It includes two standard 3-cell washers for the coarser-size ranges, one standard 4-cell unit for small nut coal, and a compound machine for fine coal. The latter is a standard 4-cell washer with a 2-cell auxiliary unit for rewashing the middlings. These five machines are served by two blowers, each with a 75-hp. motor. One supplies the two washers that treat 6- to 4-inch and 4- to 2-inch coal and the other the 2- to ¾-inch and ¾- to 0-inch washers, as well as the middlings unit.

The second installation is that of the Marriott-Reed Coal Company at Columbia, Mo., with a total washing capacity of 50 tons of 2- to 0-inch coal per hour and loading into trucks only. While small in capacity, the requirements are such that a unit washery was unsatisfactory, and therefore a specially designed, "tailor-made" plant was provided with a washery of 3-cell construction but of 2-cell size and with a middlings elevator. The Motorblower that supplies this washer is the first of the new "G" line being installed for washery service. The flow diagram of this plant is very simple, as compared with that of the Tecumseh plant, though it serves its particular purpose equally well. Between these two extremes of capacity are many washeries of intermediate size. The majority of those erected in the


Dirty Spray Water
R.O.M. SCREEN
DRIBBLE CHUTE
3/4"x0
Middlings
Crushed
1 3/4" x 3/4"
6" x 3 1/4"
3 1/4" x 1 3/4"
6"x0 Broken R.O.M.
ROM
FEEDER
BREAKER
Saturated Exhaust
DRIBBLE CHUTE
Rejects
BIN
Refuse
REWASH UNIT
STACK
Dry Fuse
COARSE COAL WASHERS
FINE COAL WASHERS
MIDDLINGS CRUSHER
MIDDLINGS CRUSHER
MIDDLINGS CRUSHER
Crushed Middlings
Crushed Middlings
Washed Coal
Return Water
Dirty Spray Water
Return Water
Dryer Effluent
SETTLING CONE
HYDRAULIC RELIEF VALVE
COARSE WASHED COAL SCREEN
Intercircuit Connection
Dryer Effluent
SETTLING TANK
Sump
FINE WASHED COAL SCREEN
Degradation
PUMPS (2)
DEGRADATION CONVEYOR
Overflow
DEWATERING SCREEN
Dried Coal
3/4"x1/2MM (Wet)
SURGE BIN
DRYERS (3)
Hot Gas
Cooling Air
EXHAUSTERS (3)
SPRAY PUMP
SUMP
Washed Coal
3/4"x1/2MM
Fuel
FURNACE
Air
Dried Coal
EFFLUENT PUMP
Slurry
Overflow
SLUDGE PUMP
Slurry
6"x3"
3"x2"
2"x1 1/2"
1 1/2"x3/4"
MIXING CONVEYOR
SUMP
Sludge
PUMPS (2)
PRIMARY CRUSHER
SCALPING SCREEN
Crushed
Overflow
Slurry
LOADING BOOMS
SLACK BELT
SECONDARY CRUSHER
SEWER
PONDS
1
2
3
4
5
6

FLOW DIAGRAM OF TECUMSEH COAL CORPORATION PLANT

Americas in recent years have incorporated impulse-jig washers of the compressed-air type. Experiments are now underway with a view to applying this process to the beneficiation of hematite iron ore.

Tecumseh Coal Corporation

The coal comes from a strip mine, the overburden being removed with an electric shovel having a dipper with a capacity of 35.6 cubic yards, the largest so far placed in service. The coal seam, the Indiana V, ranges from 4 to 6 feet in thickness and averages 5 feet. The coal is loaded by a 7½-cubic-yard electric shovel into 52-ton semitrailers. There are five of these tractors, four for regular use and one a reserve, of which four are gasoline-engine driven and the fifth is a diesel unit. Each has a 3-hp. compressor that provides air at 105 pounds pressure for operating its wheel brakes and side-dump gates.

The coal is dumped into a 400-ton-capacity hopper and is drawn from the bottom into a double-roll breaker that reduces pieces more than 6 inches in maximum dimension to that size. The breaker is served by a reciprocating plate feeder having a variable-speed drive that permits controlling the rate of feed, as desired. The broken coal is delivered to a shaker screen by a 54-inch, 7-ply belt conveyor. At its normal speed of 320 feet a minute it handles 900 tons an hour; but the plant was designed to take care of a surge rate of 1,000 tons hourly and has done so at various times. The shaker screen separates the coal into four sizes: 6- to 3¼-inch, 3¼- to 1¾-inch, 1¾- to ¾-inch, and ¾- to 0-inch. The finer sizes are sprayed as they are screened. The water for this service is put under the necessary pressure by a pump and has previously been used in the washers, thereby reducing the raw-water requirement of the plant.

Each size of screened coal goes to an individual washer. Hydraulic flushing prewets it and distributes it evenly across the width of the washer box. The finest size is accompanied by the spray water from the preceding screening operation. Washing of the three larger sizes produces clean coal, middlings, and refuse. The latter is conveyed to a bin for disposal. Middlings are crushed into three maximum sizes—3¼, 1¾, and ¾ inches—and pass on to a common belt that discharges on to the main feed belt for recirculation. The use of individual crushers makes it possible to break down each size of middlings sufficiently to prevent its return to the washer from which it came.

The clean coal from the washers that handle the two largest primary sizes is sluiced to a classifying shaker screen that divides it into two sizes: 6 to 3 inches and 3 to 2 inches. These may be loaded directly into cars or sent to a mixing conveyor. The undersize from the shaker screen (2 inches to 0 inch), together with the water from the shaker, is sluiced to a dewatering tank. It is removed from the tank by a chain drag and joins the 1¾- to ¾-inch clean coal from the third of the washers handling the three largest primary sizes. The fourth washer, which takes coal of ¾ inch and under, produces clean coal, middlings, and refuse. The refuse is sent to a bin for disposal and the middlings are elevated to a compound rewasher that delivers clean coal and refuse.

The clean coal from the third and fourth washers, all of it 2 inches or less in size, goes over a screen on which high-pressure sprays are played and which separates it into three sizes: 2- to 1½-inch, 1½- to ¾-inch, and ¾- to 0-inch. The two larger sizes are directed either to loading booms or on to a mixing conveyor, while the two smallest, together with the spray water, are sluiced to three reciprocating dewatering screens having round ½-millimeter openings. The ¾-inch to ½-millimeter coal that passes over the screens may be sent to the mixing conveyor for loading without drying, but it is commonly dried.

There are three driers, all served by one furnace. The coal goes through on a reciprocating screen and is subjected the while to a pulsating downflow of hot gases. Seals above and below the screens prevent cold air from entering. Each of the driers was designed to handle 75 tons of coal an hour to reduce its moisture content from 19 to 9 per cent. Experience has shown that half of the moisture extracted is taken out mechanically during the first few feet of travel on the screen. The furnace, which is stoked mechanically with coal drawn from the driers, has sufficient capacity to supply 400,000 pounds of gases an hour to each drier and at a temperature of 700 to 800°F. over the coal bed. This corresponds to an output of 40,000,000 Btu's an hour in summer and 50,000,000 in winter.

Automatically actuated dampers, that admit cold air when it is required, maintain a uniform temperature in the driers even though the rate, size, and moisture content of the feed may vary from time to time. These dampers are operated by compressed air. The hot gas is drawn through each drier by an exhaust fan driven by a 100-hp. motor. Each reciprocating screen is made up of two sections 5½ feet wide and 10 feet long, respectively. The chambers below the sections are separated, and the flow of gas is alternated between them by opening and closing in turn two louvre panels between the chambers and the exhauster line. The mechanism by which this is done is driven by means of the eccentric shaft of the drier, thereby synchronizing the pulsations with the reciprocating impulses of the screens that occur 320 times a minute on a stroke of 1 inch. The pulsating flow of the gas prevents fine coal from packing on the screens and speeds up drying.

All equipment in the plant except the driers is controlled from a central point. The operator starts the plant merely by pushing buttons in the proper order, thus actuating switches that control motors driving the machinery. As soon as a motor begins to function, a pilot light adjacent to its push button is turned on. The loading units are set in motion first, and then a horn in the drying room is blown to notify the attendant there to be ready to receive coal. When the latter signals back that he is prepared, the operator presses additional buttons to start the remaining units. A dial on one of the control desks indicates the tonnage of run-of-mine coal being handled, and the operator can increase or decrease the rate of feed at will.

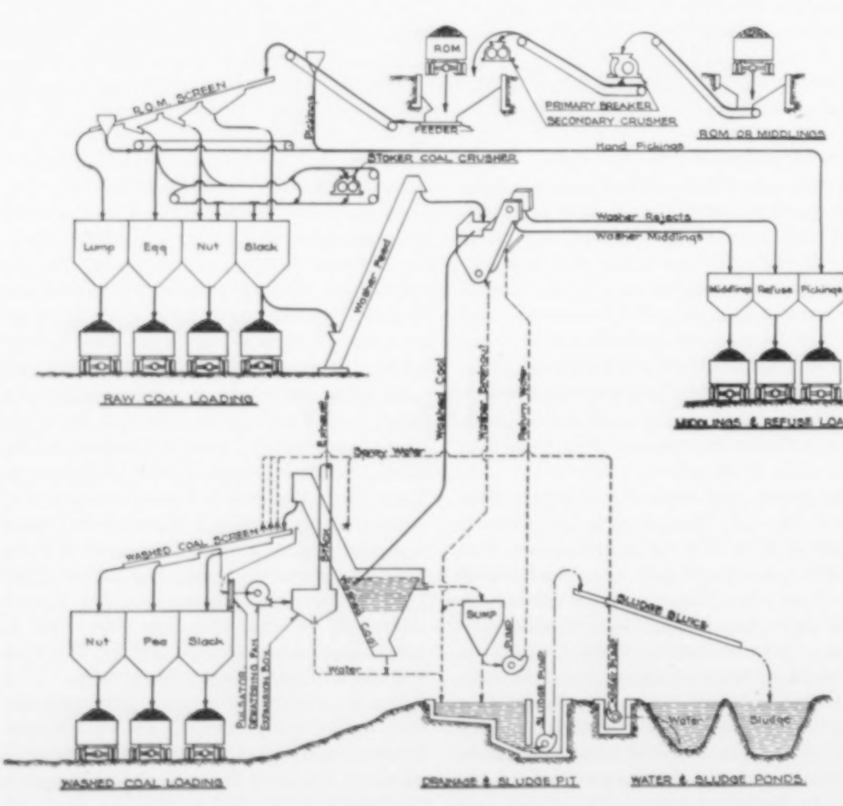
In shutting down the plant, the buttons are pushed in reverse order. However, in an emergency, the pressing of four buttons will instantly stop the three main divisions—raw-coal delivery, washing, and loading. Certain units, such as crushers, pumps, etc., are not hooked up with the emergency switches because sudden stopping would result in objectionable spillage or blockage. In case of trouble in any part of the plant, the pushing of a button at that point sounds a horn at the main control station and lights a lamp that shows the operator where the alarm originated.

From his station, the operator has a clear view of the cars on the six loading tracks below him. At his fingertips are switches that control the hoists which position the loading booms, and at his feet are pedals that actuate pneumatic valves of car retarders. The booms are provided with automatic back-loading chutes; and when a car is full, the operator raises the boom and starts loading the empty behind the loaded one. He then shifts both cars forward by means of the retarder and lowers the boom into the rear car to resume loading. Members of the ground crew detach the car-retarder cable from the forward car, permitting it to start down a slope. If a car fails to move freely when the retarder is released, or if any other difficulty develops, the operator notifies the ground crew by pushing a button that blows a horn mounted over the track concerned. As a car advances, it draws out cable from the car-retarder drum and causes a second cable to be wound on the drum for the handling of the next car. In one minute as many as three or four cars are loaded and move downgrade across scales and on to the storage yard.

Marriott-Reed Coal Company

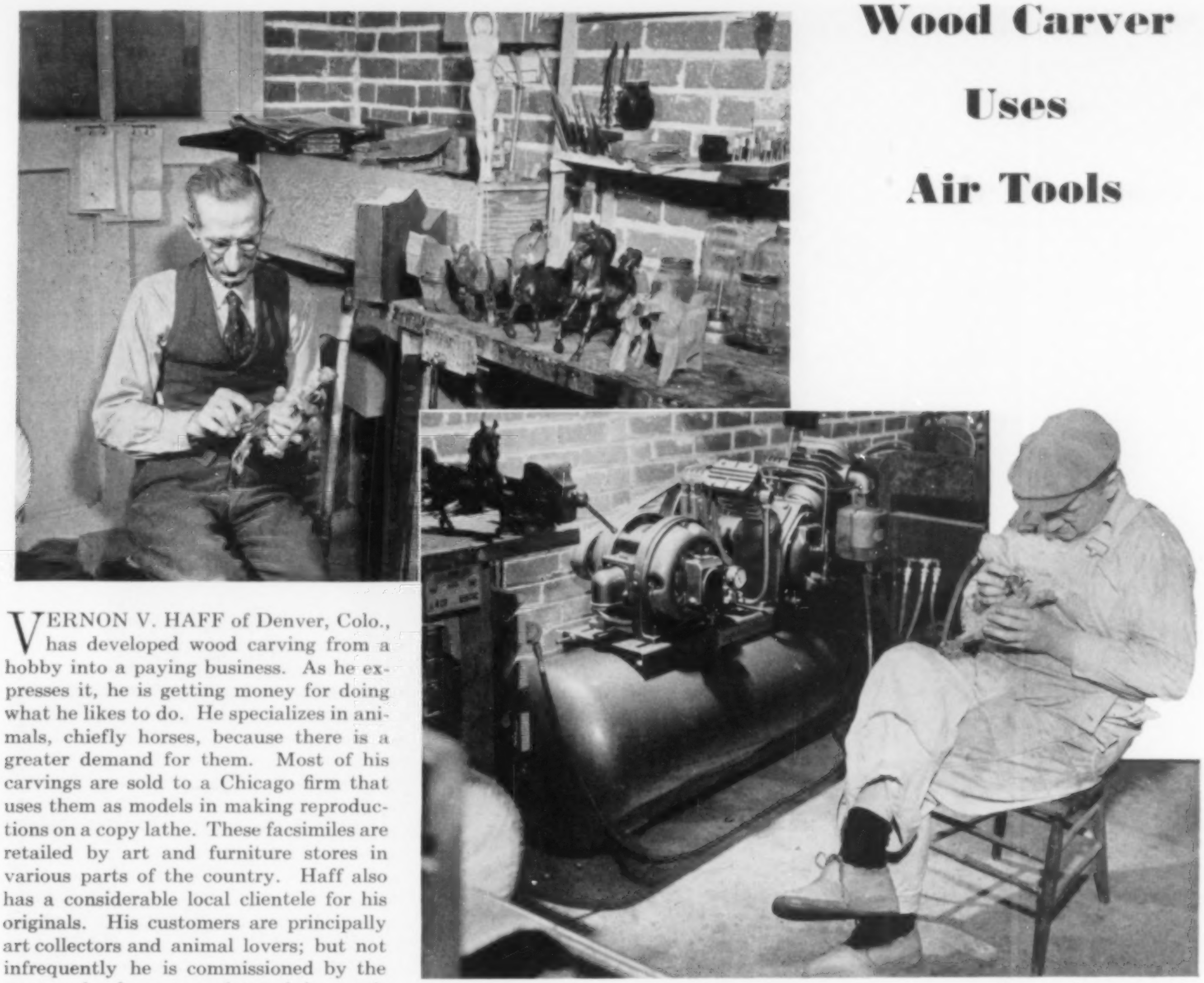
This property, near Columbia, Mo., was opened in 1936 and has since then been increased in daily capacity from 200 to 600 tons. Output is from the 26-inch Bevier seam, which is uncovered by stripping from 20 to 50 feet of overburden. Where blasting of this mantle is necessary, horizontal holes 4 inches in diameter and 70 feet long are drilled on 30-foot centers and at a level 3 to 4 feet above the coal bed, using a gasoline-engine-driven rig that can put down 600 feet of hole a day. After being shot with 40 per cent dynamite, the shattered material is cast aside with a 7-cubic-yard walking dragline. The exposed coal is broken with light charges of explosive placed in vertical holes drilled on 4-foot centers with conventional air-operated rock drills. The blasted coal is loaded by a 1¼-cubic-yard shovel into 6-ton trucks and hauled from 1½ to 2 miles to the washery. Treated coal is all hauled to market by trucks.

At the treatment plant, trucks dump into a 50-ton hopper if lump coal is wanted, or into a 20-ton hopper from which the contents are fed by an apron-type conveyor to the crushing plant. There are two crushers in tandem. The first is normally set with an 8-inch opening. Material going through it can be by-passed to a 50-ton lump-coal hopper or directed to the second crusher where it is normally reduced to 3 inches, maximum size. The feed to the plant, which may be run-of-mine coal—the product of the first crusher or of both of them—goes over 2-deck shaker screens that make four sizes: 8-inch lump, 8- to 3-inch egg, 3- to 1¼-inch nut, and 1¼- to 0-inch slack or screenings. The two smaller sizes are washed, the output being clean coal, middlings, and refuse. The latter is trucked to the mining area and deposited to be covered by future stripping. The middlings go back through the crushers and are rewashed. The clean coal descends into a settling tank and is elevated from there to triple-deck shaker screens equipped with sprays. The products are 3- to 1¼-inch, 1¼- to ¾-inch, and ¾-inch to 5-millimeter sizes, each of which is stored in a separate 60-ton loading bin. Pumps, screens, elevators, washer valves, blower, and raw coal are all operated and handled by means of push buttons from a central control panel. Sludge from the plant flows to a pond where the solids are extracted by three filters made of baled straw. The clear water passes to a 6,000,000-gallon reservoir from which it is pumped to the washers as required.



FLOW DIAGRAM OF MARRIOTT-REED COAL COMPANY WASHERY

Wood Carver Uses Air Tools



Photos by Thomas J. Barbre

AT WORK

Vernon V. Haff (above) using an air-driven grinder in carving an animal out of wood. At the left is the compressor that furnishes the motive air. His father, G.J. Haff (upper left), sands, buffs, and waxes the figures. Finished carvings and blanks in various stages of production are standing on the bench.

VERNON V. HAFF of Denver, Colo., has developed wood carving from a hobby into a paying business. As he expresses it, he is getting money for doing what he likes to do. He specializes in animals, chiefly horses, because there is a greater demand for them. Most of his carvings are sold to a Chicago firm that uses them as models in making reproductions on a copy lathe. These facsimiles are retailed by art and furniture stores in various parts of the country. Haff also has a considerable local clientele for his originals. His customers are principally art collectors and animal lovers; but not infrequently he is commissioned by the owner of a horse to sculpture it in wood.

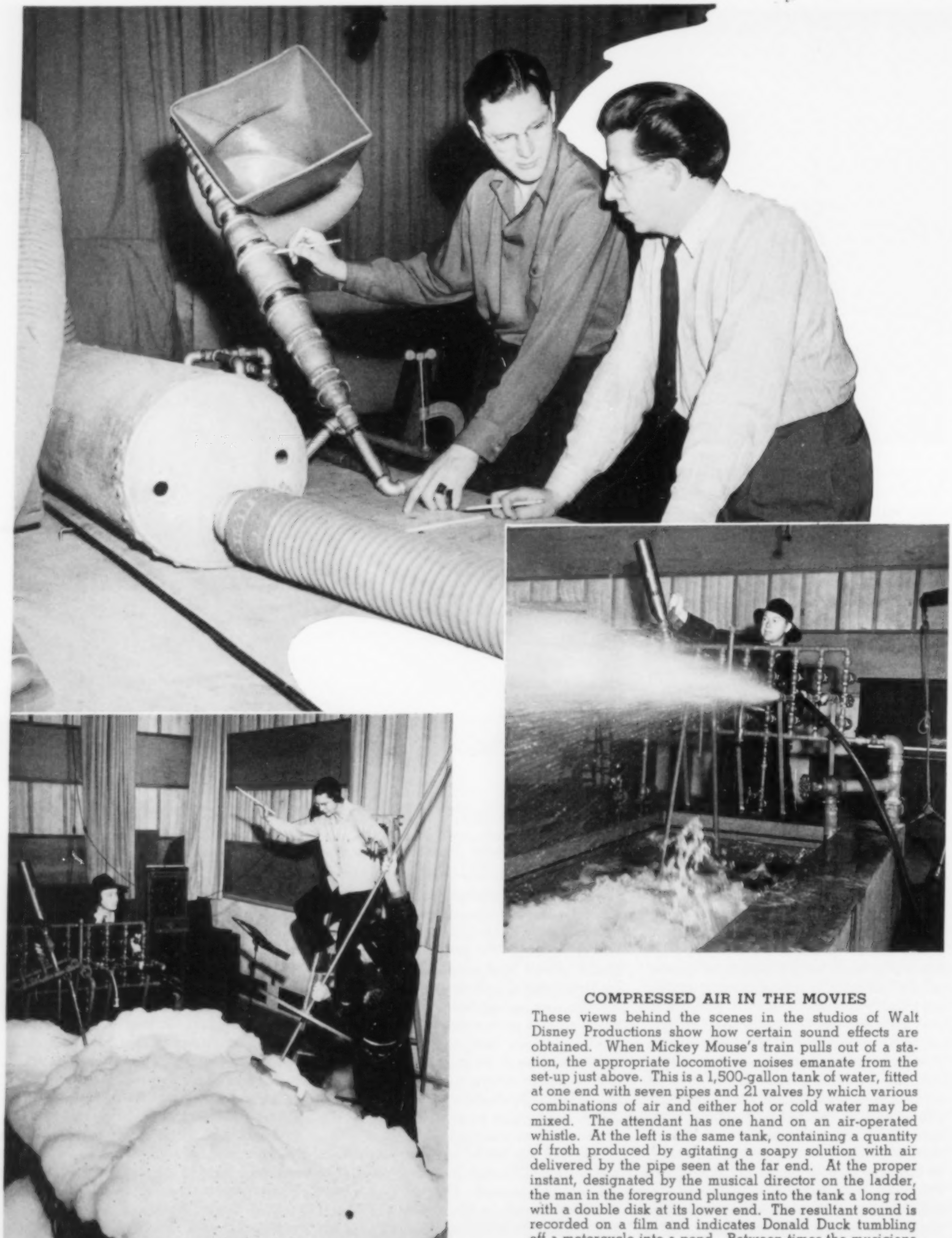
A garage in the rear of the family home serves as a workshop. Haff formerly did everything by hand, assisted only by his father, G.J. Haff. When business became so brisk that they could not keep abreast of orders, mechanical equipment was obtained. Blanks are sawed out and roughly shaped with a band saw. Then the carving is done with air-driven grinders, some of which attain speeds of 60,000 rpm. Real fine work, such as the details of horses' manes and tails, is executed with smaller electrically operated grinders; but, wherever they will suffice, the air tools are preferred because of their higher speeds.

Motive power for the pneumatic tools is supplied by an Ingersoll-Rand Type 30 air-cooled compressor. It is a 2-stage machine, with a maximum discharge pressure of 210 pounds per square inch, and is driven through V-belts by a 3-hp. motor. It delivers into a large receiver, and is equipped with automatic start-and-stop control that makes air always available when it is needed. The discharge pipe is manifolded and has connections for four hoses. A different size of grinder is used with each, and all the tools are kept ready for service, thus obviating the need of making frequent changes in connections.

After a carving is completed, the models are sanded by hand and buffed on power-driven wheels. To give them a glossy, lifelike sheen and to preserve them they are then rubbed with turpentine and wax. All the carving is done in hard woods. Black walnut predominates, but gum and tupelo also are used extensively. It is hardly necessary to state that the adoption of power-driven tools has multiplied Mr. Haff's productive capacity several times, in addition to greatly reducing the physical effort required.

Mr Haff has never had any formal art instruction, although he has studied considerably by himself. He exhibited a bent for drawing early in life, and was aided and encouraged in every possible way by his father. The latter recalls that when Vernon was only two years old he drew what was unmistakably a horse. He was raised on a Kansas farm, and there acquired an intimate knowledge of domestic animals.

Although keenly interested in art, Haff declined offers of his father to send him to an art school. He served during the first World War and developed asthma as a result of exposure to gas. About six years ago, doctors in Kansas told him he would have to move to a higher altitude. He entered Fitzsimons General Hospital, an army institution in Denver, and was a patient there for some time. While there he began carving alabaster (gypsum), and, following his discharge, he turned to wood. People began to buy his handiwork, and he commercialized his hobby. He has carved horses in all sorts of postures and in teams of two or four pulling vehicles of various kinds. He also has reproduced all manner of wild animals and some human figures. He works without any aids except the drawings used in sawing out the rough blanks. The patterns for these he prepares from his own freehand sketches.



COMPRESSED AIR IN THE MOVIES

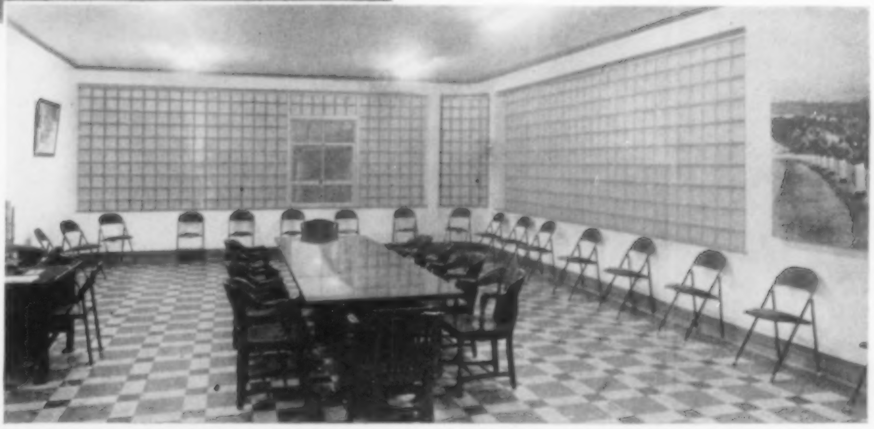
These views behind the scenes in the studios of Walt Disney Productions show how certain sound effects are obtained. When Mickey Mouse's train pulls out of a station, the appropriate locomotive noises emanate from the set-up just above. This is a 1,500-gallon tank of water, fitted at one end with seven pipes and 21 valves by which various combinations of air and either hot or cold water may be mixed. The attendant has one hand on an air-operated whistle. At the left is the same tank, containing a quantity of froth produced by agitating a soapy solution with air delivered by the pipe seen at the far end. At the proper instant, designated by the musical director on the ladder, the man in the foreground plunges into the tank a long rod with a double disk at its lower end. The resultant sound is recorded on a film and indicates Donald Duck tumbling off a motorcycle into a pond. Between times the musicians busy themselves devising gadgets to produce new sound effects. When fed with compressed air from the studio lines, the apparatus pictured at the top of the page simulates the noise made by a mountain-climbing freight train.

MODERN MACHINERY AGENCY

Exterior and interior views of the new home of the Charleston Tractor & Equipment Corporation. Above is the spacious display floor, showing air-operated tools in center foreground, and below the 20x50-foot sales and conference room.

CHARLESTON TRACTOR
& EQUIP. CORP.

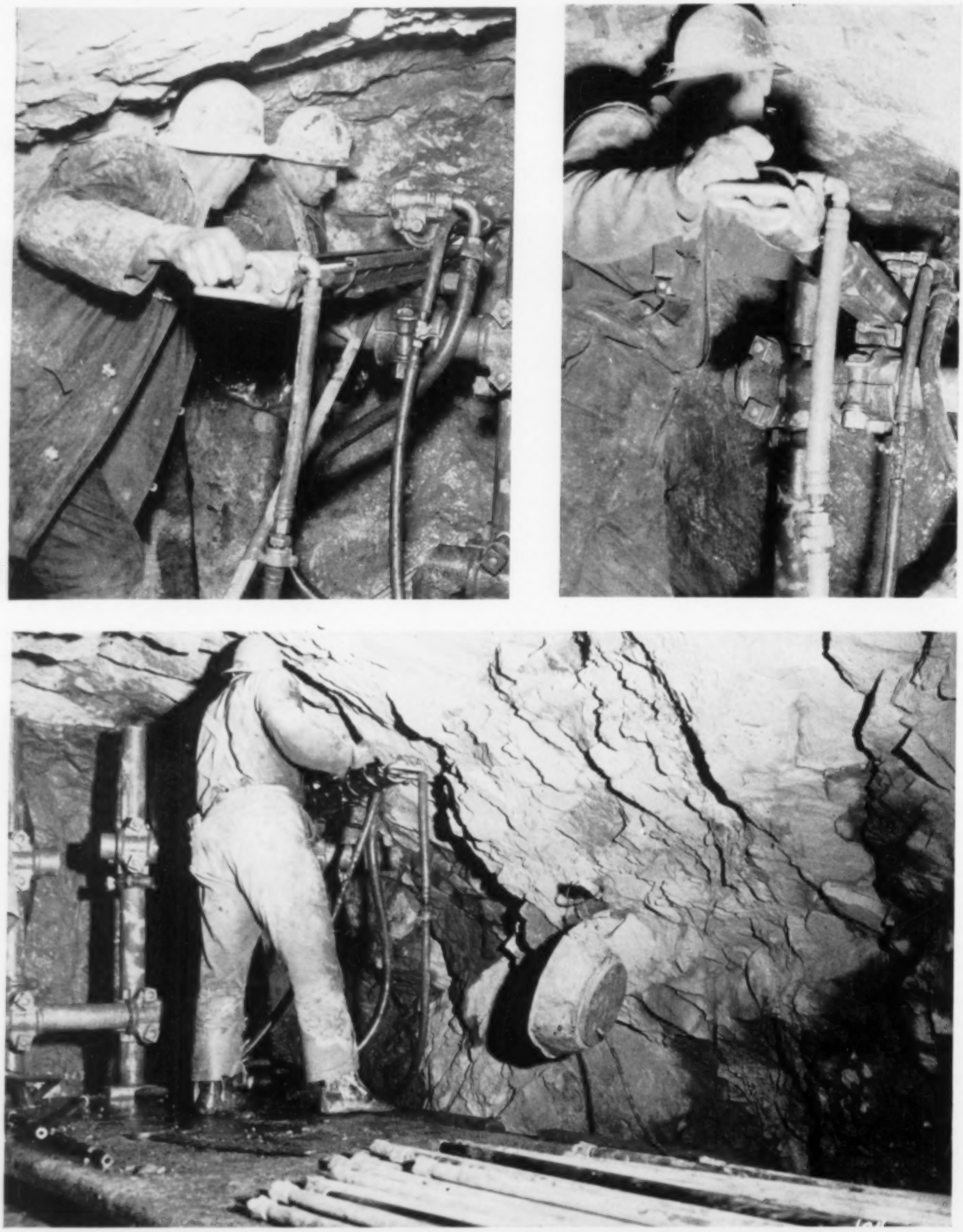
Machinery Row Dresses Up



ONLY a few years ago, establishments selling contractors' machinery and equipment were usually stodgy, unattractive places, both inside and out. Ordinarily located in a run-down section of a city and housed in old, grimy buildings, the tenants of "machinery row" scarcely received a second glance from the casual passerby. Within doors, a funereal appearance prevailed, with dark, littered offices, antiquated furniture, and dust-covered miscellanies of tools and equipment scattered about in jumbled profusion. Only a person who really needed something sold there would be drawn inside.

Today these conditions are much changed. The down-at-the-heels, junky type of machinery houses are giving way to spick-and-span structures of pleasing architecture, sparkling glass, and glinting metal trim. Some of these buildings have invaded the better part of town and they don't look out of place there. Attractive window displays of streamlined, sleekly painted machines and tools command attention. Inside, bright and airy offices with shining desks, well-ordered filing cases, and modern mechanical aids greet the eye. Adjoining the salesrooms is a spacious showroom where machines are exhibited to best advantage.

Exemplifying these up-to-date agency headquarters is the new home of the Charleston Tractor & Equipment Corporation, Charleston, W. Va., which is illustrated on this page. It combines a 2-story office and display section with a 1-story unit containing repair shops, parts storage, and shipping department. Brick and tile are used as wall materials for the first floor, while the second story is composed chiefly of hollow glass bricks. The showroom is inclosed largely by plate-glass windows set in aluminum frames. Air-conditioned offices insure all-year comfort, and fluorescent lights in offices and display room provide excellent nighttime illumination. The building has ground dimensions of 120x204 feet. The showroom measures 50x120 feet, the office space 50x 80 feet, and the service, parts, and storage section 120x154 feet. The concern, which has had a rapid growth since its founding in 1934, is the selling agent for a diversified line of contractors' and roadbuilders' machinery, including Ingersoll-Rand compressors, rock drills, and accessory equipment. It has 40 employees.



DRILLING SCENES IN THE CONTINENTAL DIVIDE TUNNEL

Camera studies made by Thomas J. Barbre showing DA-35 drifter drills at work on the East Portal heading of the 13.06-mile bore which is being driven to divert water from the western slope of the Divide, where there is an abundance of it, to the eastern slope where it is needed to help irrigate 615,000 acres of land now under cultivation. The tunnel forms part of the Colorado-Big Thompson Project of the U. S. Bureau of Reclamation. The pictures illustrate individual drills of a group of five mounted on a drill carriage. Note Jackbits on drill steel in foreground.

Speeding Munitions Work

IN LESS than a year, American industry has accomplished wonders in defense work. The remarkable part of it is that some of the greatest progress has been made by concerns that switched from their regular products to others that they knew little about. A striking example of this is the record made by some of the units of the automobile industry in turning out machine guns. Four accessory plants were asked last September to undertake the manufacture of machine guns and to reach mass production by the beginning of 1942. In April of this year, when only half the allotted time had expired, they delivered their first consignment of finished weapons, and this despite the fact that most of the executives and engineers of the plants concerned had never seen a machine gun. Similar almost unbelievable achievements have been registered in other fields, and all of them prove that there are few obstacles that cannot be surmounted by an industrially advanced people when given free rein.

From its arsenals the Government supplied the automotive manufacturers with machines designed to make essential gun parts; but they were found to be from 21 to 73 years old and arranged for belt drive from shafting. They were reconditioned, retooled, and provided with individual motors, and to augment them, equipment was borrowed from automobile production lines. Meanwhile, some of the Government's machines were loaned to schools that were organized to train the 10,000 operators and supervisors that would be needed when the plants got into full swing.

The manufacturing facilities were set up in accordance with automobile assembly-line practices, with overhead conveyors to move the parts through the successive stages and on to the test firing range and shipping room. Innovations were introduced without regard to tradition wherever they promised to save time or to do a job better. Instead of filing each of the 285 parts of the average gun, tumbling barrels were adopted and speeded up this finishing operation nine times. A special machine was built that would drill the bores of six barrels simultaneously, instead of one at a time. Cemented-carbide cutting tools were substituted for high-speed-steel tools, and more time was saved. Machinery used for making sewing machines was adapted for the production of some of the small gun parts; and methods developed for manufacturing valve stems were applied to turning out firing pins. For rifling gun barrels, automotive engineers designed equipment that has reduced the number of operations from fifteen to two. And so it has gone, down to the final job of cleaning the gun barrels after test firing. There the advance has been phenomenal, the work being cut down from 48 hours to less than a minute.

Numerous other examples of speeding up might be cited. During World War I, the average plant making 650 shells of 75-mm. diameter daily performed 25 operations on each one and used 35 machines manned by 27 operators. Today, leading arsenals are turning out the same number of shells in seventeen operations with 13.43 machines and 12.73 operators. In view of these and equally impressive achievements, there is little cause for worry about decadence in American progressiveness and inventiveness.

Minerals and the War

NO INFORMED person any longer doubts that the current conflict is a war of minerals. Never since the ancient Greeks and Romans employed catapults for throwing rocks at enemy forces have the materials that come from the ground been so important in warfare. The armorer that clad the fighters of the Middle Ages in protective garments has his modern counterpart in big factories; but there is an essential difference. These plants are not intent on clothing the individual in metal: they are building armored tanks, airplanes, and other conveyances—the protection goes on machines not on men.

From this turn to new tools of conquest emerge two facts: First, that the individual combatant has a better chance of survival than he had in World War I; and, second, that preparation behind the lines is now vastly more important than ever before. Developing this second point, it may be said that wars are today largely won or lost in a nation's factories. Bearing out this contention are some statistics put forward by the National Machine Tool Builders Association. These figures show that in Caesar's time the soldiers themselves made practically everything they required in battle. Not until 1870 was there need of one man at home for each one fighting. By 1918, every man in the ranks had to be backed up by five men in factories. Today the proportion is estimated at eighteen to one. Compared with the last war, soldiers now fire a rifle three times as fast, travel ten times farther in a day, and have bombing planes with a range 32 times greater.

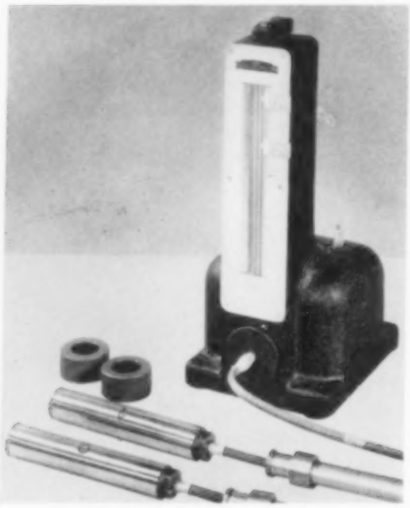
This increasing emphasis on the man behind the firing line makes industry the primary battlefield. Unless he is adequately supported at home, the soldier might as well never take to the field. And in this support metals play a dominant part. In fact, many economists believe that the aggressor nations are motivated in this war largely by their desire to gain control of essential minerals for commercial and industrial development. Without an abundance of coal, iron, copper, lead, zinc, and some other natural products they can never gain equality in world trade with the nations that are liberally supplied with these materials. At the beginning of hostilities, the British Empire and the United States together controlled most of the deposits of iron, petroleum, coal, manganese, chromite, nickel, molybdenum, copper, and tin, as well as the lion's share of gold, silver, and diamonds. The Axis powers controlled only four important minerals—mercury, aluminum, potash, and nitrate.

Air Gauge Checks Long Bores with Facility

IN THE manufacture of small arms and guns it is essential that the diameters of the bores be checked with precision. This work presents no difficulty with the conventional internal gauges where the ratio of bore length to bore diameter is small, but it calls for a high degree of skill on the part of the operator where that ratio is large. To eliminate the troublesome human equation, to maintain maximum precision standards consistently, and to speed up the inspection of gun barrels, as well as of all relatively inaccessible diameters, The Sheffield Gage Corporation has developed an instrument named the Precisionaire. This gauge is of the flow type, as distinguished from the pressure type, and depends for its operation on the velocity of constant-pressure air.

The Precisionaire is available in two models: A, which is designed for heavy parts that must be checked while still on the cutting machine, and B, which is suitable for parts that are light enough to handle and can be presented to the instrument. Our interest is in Type A, the gun gauge, which is provided with a tubular handle connected to the recording instrument by a flexible tube and which carries an interchangeable gauging nose. The handle is of sufficient length to pass through the bore to be checked, and the nose is essentially a cylindrical plug with a central air channel that terminates at a point just back of the front end in one or more air jets in the side of the cylinder.

Compressed air taken from the regular plant line is the actuating medium and, because of the construction of the Precisionaire, is always maintained at constant pressure. There is a free flow of air throughout the gauge assembly, the volume and velocity at any given instant depending only on the clearance between the nose and the wall of the barrel being checked. The greater this clearance, the greater the volume of the air and the higher the velocity. There is a freely moving float in the indicator tube of the recording instrument, and this reacts instantly to any change in velocity, regardless of the distance between the gauge and the work being inspected.



GUN-BORE GAUGE

This is a Model A Precisionaire which, together with its companion Type B, is suitable for checking the diameters of bores and rifling from the smallest-caliber weapon to the largest naval gun, as well as out-of-round, taper, or bell-mouth work. To the left of the gauge are shown the two master rings by means of which the permissible tolerance of the part to be inspected is indicated on the recording instrument, and immediately in front of them are two gauging noses. Each of these is attached to a long tubular handle by a flexible or self-centering connection that keeps it in alignment in its passage through the barrel of a gun.

In operation, with the compressed air turned on, a minimum master ring is slipped over the nose and the pressure of the air is adjusted so that the float will rise to a point just above the bottom of the transparent indicator tube. After one of two sliding markers on the face of the instrument has been set opposite the float's position, a maximum master ring is substituted. This causes the float to take a new and higher position, which is indicated by the second marker. The section of the tube between the two markers represents the difference in diameter between the master rings, or the permissible tolerance for the work to be gauged. By means of a graduated scale alongside the tube, this section can be calibrated into any number of equal divisions. For example, if the tolerance is 0.001 inch, and the markers are 5 inches apart, each half inch thereof would be equivalent to 0.0001 inch; and in actual service, as the gauging nose advances through the barrel of a gun, the float will show the exact diameter every step of the way. If the latter remains within the limits set by the markers, then the gun bore is acceptable.

Plywood Plastics in Airplane Construction

MASS production of airplanes is envisioned in the near future as the result of highly successful tests with plastics developed primarily with that industry in mind. The first step in this direction was the use of transparent plastics which have all the properties of glass but are shatterproof, light in weight, and can be molded into any desired shape. Next, in an effort to reduce dead weight and to give flying machines greater carrying capacity, or a wider radius of action, many small parts and housings inside the craft were made of opaque plastics. In this connection it is of interest to mention that 50,000 individual pieces enter into the construction of some planes. Now, there is every indication that fuselages, together with all the inside ribs, bracings, and stringers, will be molded, as well as wings, tail-plane assemblies, etc., each of the latter in one operation.

Some of the plastics that have been developed primarily for airplane manufacture differ from the materials commonly placed in that category. They are not made from organic compounds but from plywood pressed into shape in molds much like metal castings are produced. Extensive experiments are being conducted at the Mellon Institute in Pittsburgh, Pa., and the U.S. Bureau of Standards to determine which of the available materials are suitable for plane construction, and how, or for what purposes, they should be used. These investigations have revealed that three of the eighteen so far tested could withstand the stresses to which they would be subjected in flight, and that by far the best results have been obtained with a combination of laminated wood and resins.

One of the plywood plastics, which has been in process of development for three years, is said to have exceptional characteristics. It is made by the Vidal process of thin sheets of tough aircraft wood which is given greatly increased strength by impregnating it before molding with resinous substances. To assure thorough impregnation, the air is withdrawn from the cells under a vacuum, thus permitting them to be completely filled with the resins. The veneer is laid crisscross and in various patterns in a mold which, in turn, is placed in a cooking tank where it is subjected to live steam and high pressure.

The resultant product is said to be exact in shape and inside dimensions, to have a fine finish that requires little if any machining, and to be considerably stronger and more rigid than steel. It is coated with plastic paint applied by the spray method, and this gives it a hard, waterproof surface that is also exceptionally resistant to abrasion. The fuselage of a 42-foot bomber has been made by the Vidal process and is claimed to be the largest airplane part that has ever been molded. It has undergone exacting tests, and preparations for its mass production have been completed. It is more than 10 per cent lighter but has greater carrying capacity than a structure of the same type built of conventional materials. Two experimental planes, which have been constructed in their entirety of this plastic-veneer, have passed all material and load tests of the Civil Aeronautics Board and are in use today.

Industrial Notes

"Let compressed air do it," might well be the motto of the garage or service man, because it helps him in so many ways and relieves him of much back-breaking work in the course of a routine day. The newest gadget designed for his convenience blows old grease out of transmission and differential housings of all makes of motor cars and trucks. As ordinarily done, this is a dirty job. But now, we are told, he simply removes the top plug of the differential or transmission housing, or both; screws in a fitting—Quick-Kleen unit *D* (differential) or *T* (transmission); applies a "fitall" adapter to which the air hose of the tire-inflating equipment is attached; takes the lower plug out of the housing; and opens the air valve. What happens? Pressure builds up in the housing and forces out the grease. In the case of the latest model cars he may also have to loosen bolts on the back plate of the differential housing to provide a space for the discharge of the grease. The two fittings are threaded for plug holes of varying diameters, and the adapter screws into either end of either fitting.

D UNIT ADAPTER T UNIT

Does your watchman make his rounds regularly? You can keep watch on him by providing him with a key with a counter that shows at a glance the number of times he has stopped to register. The combination of the key is said to change automatically each time it is used, and will unlock only the next station in his schedule.

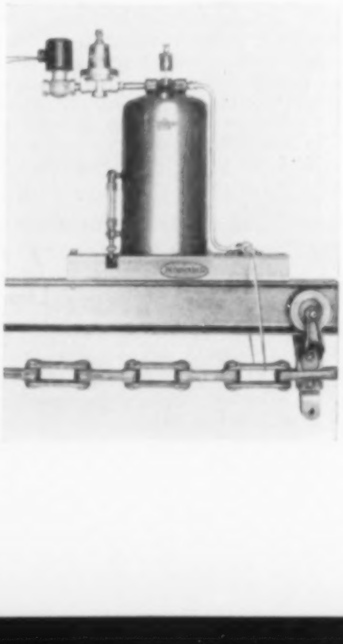
In a new type of high-speed developer, the sensitized paper and tracings are fed into the front of the machine, where they are immediately exposed in the printer section, and the developed prints are delivered flat and dry at the rear. The tracings are returned to the operator through the medium of a vacuum roll that separates the tracings and the prints, permitting them to move in opposite directions.

All-steel mine cars, 300 of them being built along modern lines by the Irwin Foundry & Mine Car Company, are being provided with rubber springs developed by the United States Rubber Company. Eight springs constitute an installation. Four of these are of the shear type and carry the load of the vehicle when empty, or an aggregate of 5,000 pounds, and four of the compression type take the total weight—19,000 pounds—of the car when laden. It is claimed, among other things, that they reduce the danger of derailment by exerting a load of 1,400 inch-pounds on each wheel.

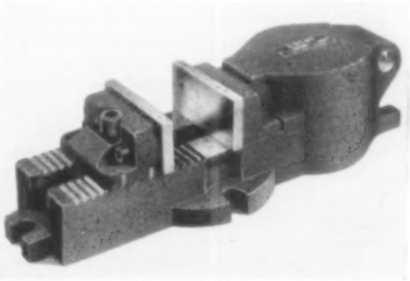
In trend with the times when just about everything comes cellophane wrapped, a manufacturer is offering individual containers for small tools to protect them when in the storeroom or on display. They are made either of transparent or opaque plastics, the latter in a variety of colors; are marked for identification; and have easily removable sliding covers.

Despite the tremendous increase in the volume and speed of automobile travel, American motorists will require only half as many replacement tires to keep their cars rolling in 1941 as they did in 1928, says J. J. Newman, vice-president of The B. F. Goodrich Company. Thirteen years ago replacement sales reached 52,470,000 tires, an all-time high, and last year, with 31,010,000 or one-third more cars registered, they totaled 39,037,000, including spares on new machines. This represents an average of 1.26 tires per car, as contrasted with 2.27 in 1928.

Chain conveyors that are designed to travel through ovens, kilns, and other hot zones, must be kept well lubricated if the required rate of speed is to be maintained. This is essential, for any slowing down might impair the product being baked, cured, or otherwise heat treated. In the case of ceramics, for example, it would result in uneven firing. With these requirements in mind, the J.N. Fauver Company, Inc., has introduced an automatic lubricator that starts to operate the instant the conveyor begins to move and continues to function until it stops. It consists essentially of a 2-gallon tank connected with a plant's main compressed-air line, and of a regulator set at 80 pounds pressure. The air, in passing through the unit, picks up a predetermined amount of lubricant and delivers it, in the form of an oil fog, through small-diameter copper pipes to both sides of the chain links. The spray is adjusted in accordance with the temperature of the kiln and the speed of the conveyor. Acheson colloidal graphite is used, and the mixture and its application are controlled so nicely, it is claimed, that each chain pin is lubricated from end to end every trip with no excess to cause dripping.



Airlox is the name of a pneumatic vise that is said to combine the quick action of compressed air with the grip of a screw vise. It is made by Production Devices Incorporated and is suitable for machine and bench work. Our illustration shows the Standard Type which has an over-all length of 20 inches, a width of 7 inches, and is $4\frac{13}{16}$ inches high. The jaws can be adjusted in $\frac{3}{16}$-inch steps to a maximum width of 5 inches and the maximum travel is $\frac{5}{8}$ inch. The vise is actuated by a single-acting air cylinder in connection with opposed cams, and equipped for either hand, knee, or foot control by an air, electric, or cam-operated valve. With the use of the latter it is possible to synchronize the opening and closing of the jaws with the movement of a milling-machine table, thus eliminating all manual control and speeding up production. A smaller model, the Midget, is available for lighter work. Air at from 25 to 150 pounds line pressure is used, depending on the material to be held in the jaws; and in the case of the Standard Type, the grip exerted on the work is claimed to be 40 times the air pressure at the vise.



Prefabricated culverts made of laminated wood impregnated with creosote by the pressure system are offered contractors by the Wood Preserving Division of the Koppers Company, Pittsburgh, Pa. The sections interlock cornerwise and lengthwise, forming a solid structure that can, it is claimed, withstand a load in excess of 20,000 pounds. A booklet, *Pressure-Creosoted Laminex Culverts*, which may be obtained upon request from the manufacturer, gives a list of the sizes obtainable, shows how they are assembled, and contains other facts that would be of interest to possible users.

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INTERNAL COMBUSTION ENGINE NEWS

★ ★ ★ NEWS FLASHES FOR POWER USERS ★ ★ ★ 962-7

Prepared by Ingersoll-Rand Co.
Main Office: 11 Broadway, New York City
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The World Over

Former Rivals Cooperate

It may surprise many readers to learn that the Diesel engine is not necessarily the enemy of steam power. Two news items on this page describe plants in widely varying fields, in which a Diesel engine is working in close harmony with a steam power plant, thereby effecting higher economies than would be possible if *all* of the power were produced by either Diesels or steam.

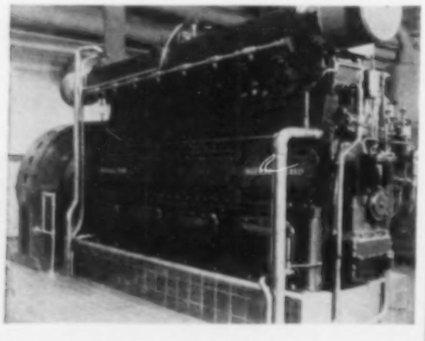
At Sea

In the Maritime Commission installation the main power plant was preferably steam, because of the large amount of power involved. The Diesel engine was added to handle certain peak loads conveniently. The moderate expenditure for the Type "S" Diesel avoided a much larger investment increase for additional boiler capacity, condensers, boiler feeds pumps, main circulators, etc. With the Diesel engine it is also possible to remove both boilers from service for inspection in port, without interrupting the ship's service.

On Land

In the Seagram installation a large quantity of exhaust steam could be used for process work, and a non-condensing steam plant produced power and supplied this steam at the same time. When more power was required, however, no additional process steam was necessary. Hence the installation of a Diesel-generator set was more economical than a new condensing steam plant, both in first cost and in operating cost.

There are many similar places in industry where a combined plant could be profitably applied, and it is a tribute to the progressiveness of Diesel and steam engineers that, instead of fighting each other, they are cooperating in a way which was not deemed possible in the past.



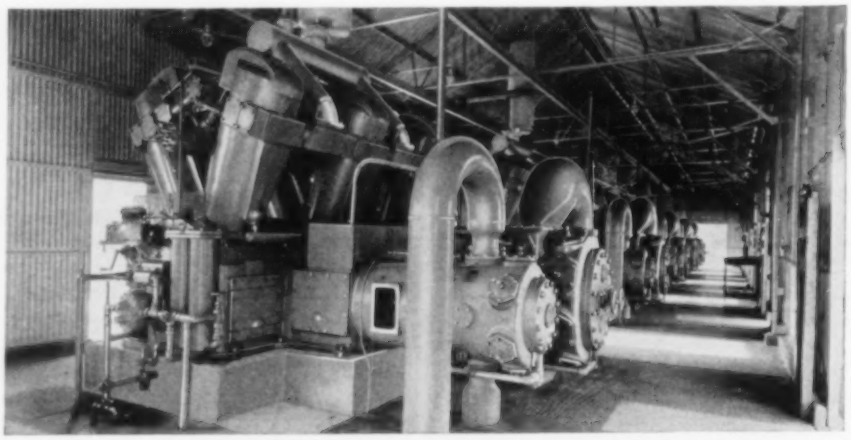
Eight-cylinder Type "S" Diesel generating set in the Seagram distillery at Lawrenceburg, Ind.

Diesel Auxiliary Engine Power in Maritime Commission Steamships

Independent Power Supply Permits Complete Shutdown of Steam Plant Without Interrupting Service

NEWPORT NEWS, VA.—350-KW Ingersoll-Rand Type "S" Diesel engine generator sets have been installed on the SANTA ANA and the SANTA TERESA, built under the Maritime Commission at the Newport News Shipbuilding & Dry Dock Co. Steam is used on these vessels for main propulsion and for normal ship service. The Diesel generator set provides peak power for pulling down the temperatures in refrigerating space at the beginning of the voyage, and to take care of ship's service in port, when the boilers are shut down for inspection, cleaning or repairing. A ship duplicating this unusual power plant, is now in the process of construction at the Federal Shipbuilding and Drydock Co., Kearney, N. J.

Gas-Engine-Driven Compressors in Oil-Field Service



Five direct-connected, gas-engine compressor units, totalling 2400 hp. are compressing natural gas in the new gasoline extraction plant of the Shell Oil Company, in Magnolia, Arkansas. Two similar units, each of 650 hp., have just been installed in a modern natural gas recycling plant in Texas. There the gas pressure is raised from approximately 1400 lb. to 2150 lb., the discharged gas being returned to the ground. Many such plants have gone into operation in the mid-continent field during the past several years.

Diesel-Engine Compressors in Reed Co. Plants

ROCHESTER, N. Y.—In February, 1928, the F. E. Reed Glass Company installed two Ingersoll-Rand 100-hp. Type POC-1 direct-connected, oil-engine-driven compressors in the Mt. Read Blvd. plant in Rochester. Later another unit was placed in the Maple Street plant, and for many years these three machines produced air for manufacturing operations. Recently, when additional capacity was required, the company installed in each plant an Ingersoll-Rand Type 4-XVO-1 oil engine compressor unit—the type which has superseded the original POC units.

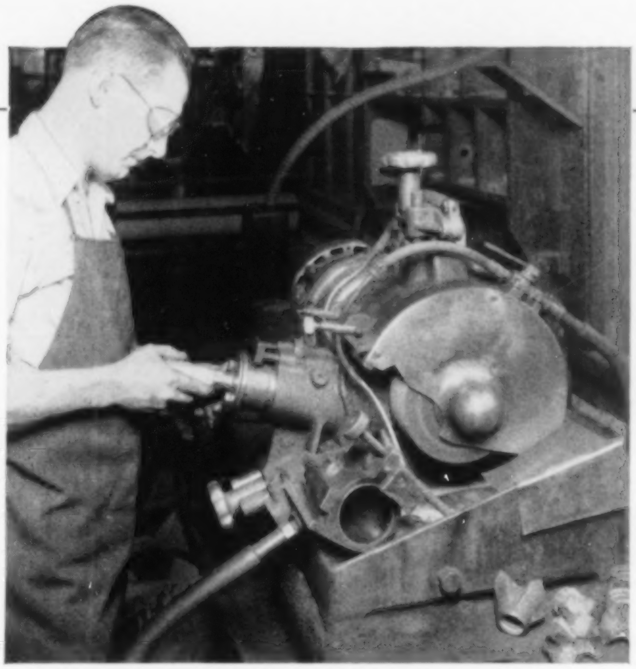
Diesel Engine Balances Heat Cycle at Seagram & Sons

New Engine Improves Control of many Distillery Processes

LAWRENCEBURG, IND.—Unique advantages are credited to the installation of an Ingersoll-Rand Type "S" Diesel-generator set in the Lawrenceburg, Ind. distillery of Joseph E. Seagram & Sons, Inc. Not only has the unit saved money in supplementing an existing non-condensing steam plant but the quality of the plant's chief product, whiskey, has been improved! Previous to two years ago, all power was developed by steam, and blending, bottling work and other operations requiring power were governed by the need for exhaust steam used in mashing and distillation. The former operations can now be carried on independently of the latter—and hence can be performed at the exact time most desirable to improve the quality of the product.

Panama Canal Buys Diesel-Engine Compressors

A drill boat recently purchased by the Panama Canal Commission, will be equipped with four Ingersoll-Rand direct-connected oil-engine driven compressor units of the XVO type. Each unit compresses 1250 cfm of air to 100 lb. discharge pressure. Because of the "V" construction, this type of unit is particularly adapted for installation on a drill boat; unbalanced rotative forces are reduced to a minimum. The compact design is very saving of space and the direct-connected feature results in a low cost of compressed air.



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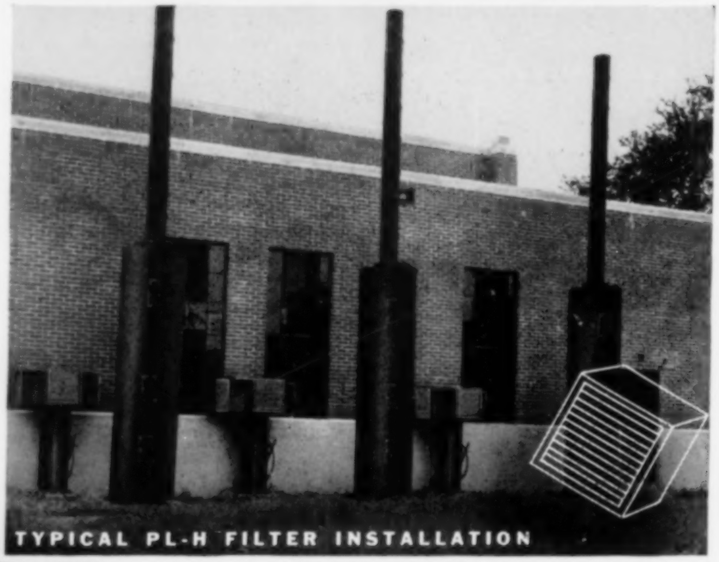
TYPICAL OC-H FILTER INSTALLATION

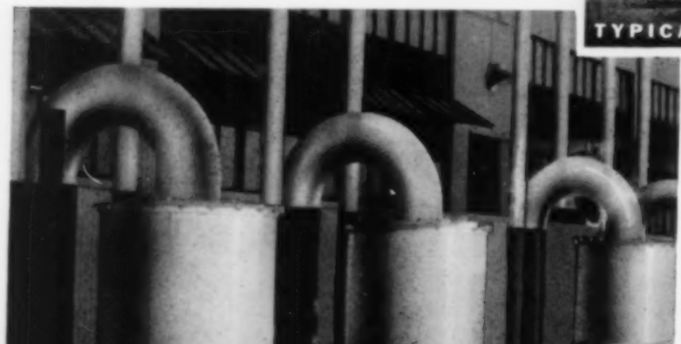
The engineering experience gained through 18 years of designing air cleaner installations for diesels, gas engines, and compressors enables the American Air Filter Company to offer the only complete line of air cleaning equipment available for this service.

Illustrated, in use, are three types of AAF air cleaners. Bulletins describing their construction and application are available on request.

(Below) CYCOIL OIL BATH AIR CLEANER—combines four distinct methods of cleaning the air: (1) impingement of the air against the surface of the oil to remove the larger and heavier dust particles; (2) scrubbing action of the air against oil-coated surfaces; (3) cyclonic action with centrifugal force to throw the oil spray out of the air stream; and (4) filtration as the final cleaning stage before the air enters the engine or compressor.



TYPICAL PL-H FILTER INSTALLATION



TYPICAL CYCOIL OIL BATH AIR CLEANER INSTALLATION

(Above) TYPE OC-H FILTER—is a complete assembly consisting of washable viscous impingement type filters mounted in a housing ready to bolt to air intake pipe. 1—2—3 or more cells are employed depending upon the amount of air to be handled.

Write for Bulletin No. 120C.

(Below) TYPE PL-H FILTER—is a complete assembly consisting of housing, ready to bolt to intake pipe, and dry cell type filters in which wool felt constitutes the filter medium.

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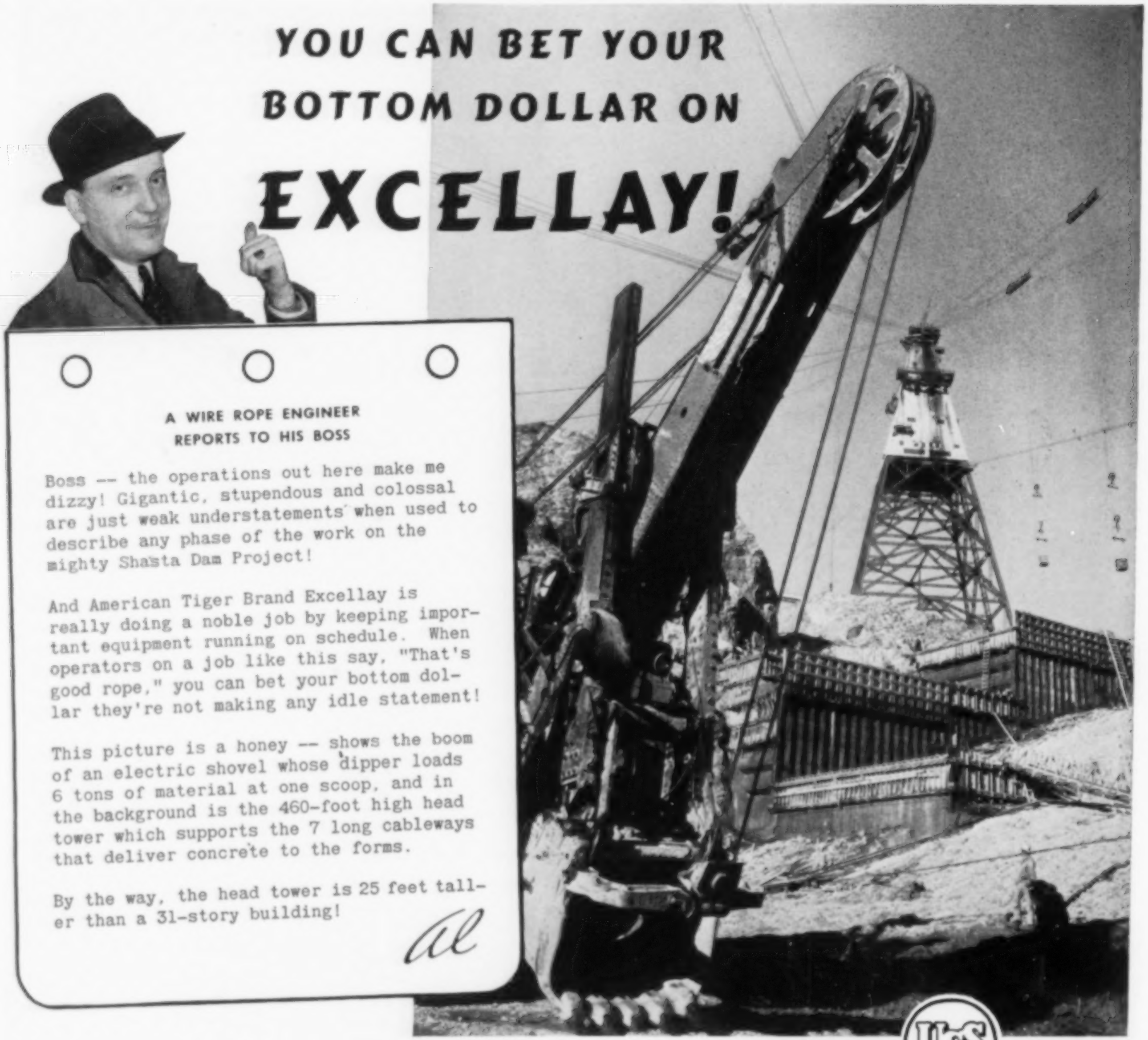

A WIRE ROPE ENGINEER REPORTS TO HIS BOSS

Boss -- the operations out here make me dizzy! Gigantic, stupendous and colossal are just weak understatements when used to describe any phase of the work on the mighty Shasta Dam Project!

And American Tiger Brand Excellay is really doing a noble job by keeping important equipment running on schedule. When operators on a job like this say, "That's good rope," you can bet your bottom dollar they're not making any idle statement!

This picture is a honey -- shows the boom of an electric shovel whose dipper loads 6 tons of material at one scoop, and in the background is the 460-foot high head tower which supports the 7 long cableways that deliver concrete to the forms.

By the way, the head tower is 25 feet taller than a 31-story building!

Al

A GOOD way to get good service out of your wire rope is to take full advantage of the wide experiences of American Tiger Brand Wire Rope Engineers. Our field engineers are interested in seeing that you get a full dollar's value out of every dollar you invest in wire rope. That's why you'll find them right out where the rope is used—that's where they spend most of their time. There's no better place to keep in touch with wire rope performance.

These engineers are well qualified to give you exactly the service you need—speedily, too! Besides helping you to select the most practical wire rope for a particular job, they can often give you valuable, money-saving tips on operation. And there's no obligation.

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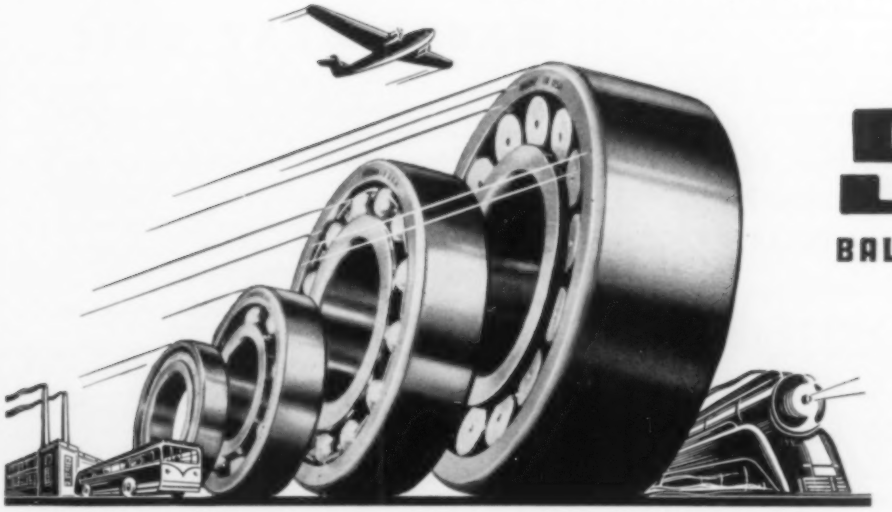

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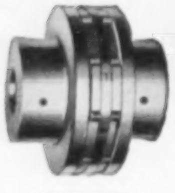

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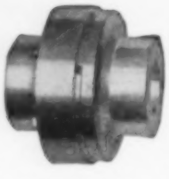
1/6 to 50 h.p. at
1750 r.p.m.



TYPE "H"
Heavy Duty
1-½" to 9-½"
2-½ to 806 h.p. at
100 r.p.m.

YOUR dollars go further when you use L-R Flexible Couplings. It has paid others to use them and it will pay you too! L-R engineers can help you on flexible coupling requirements—and if standard couplings do not meet your needs—they will work out new designs that will.

COMPENDIUM AND CATALOG: Engineers interested in new ideas about power transmission, as related to flexible couplings, **Write for this catalog.**

LOVEJOY FLEXIBLE COUPLING CO.

4951 W. LAKE STREET CHICAGO, ILL

R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.

R. C. PILOT VALVE
STRAINER TYPE

R. CONRADER CO.

1207 FRENCH STREET - ERIE, PA.

PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

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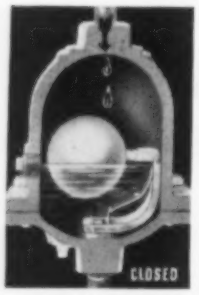
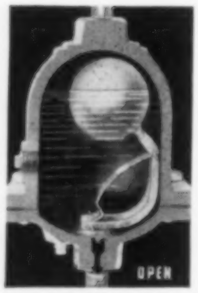


THE ARMSTRONG Snap-Action AIR TRAP



HERE'S what you've been looking for to give you dependable automatic drainage of water from compressed air separators, aftercoolers, receivers, lines, etc.

1. Immunity to Ordinary Dirt Troubles. Pays for itself by reducing your maintenance expenses.

2. Operates Without Air Loss. Guards against excessive power costs.

3. Self-Priming. Completely automatic.

4. Large Capacity. 1400 lbs. of water per hour at 125 lbs. pressure—1000 at 250 lbs.

5. High Quality Construction. Heat treated valve, stainless steel trim.

Automatic Drainage
COMPRESSED AIR SEPARATORS, AFTERCOOLERS, LINES, ETC.
ARMSTRONG AIR TRAPS

ASK FOR YOUR
COPY OF THIS
NEW BULLETIN

write to

**ARMSTRONG
MACHINE WORKS
885 Maple St.
Three Rivers, Mich.**

CONSERVE WASTE
EXHAUST HEAT

WITH A MAXIM
WASTE HEAT UNIT

With the new Maxim Waste Heat Unit, exhaust heat that usually heats all outdoors, can be put to work producing useful hot water or steam for your plant.

In addition this unit gives you efficient silencing of exhaust noises and, in cases where it is necessary, a positive spark arrestor.

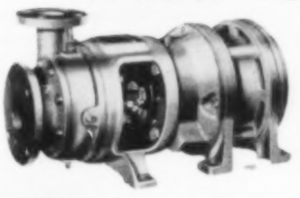
We will be glad to supply you with detailed information.

THE MAXIM SILENCER CO.

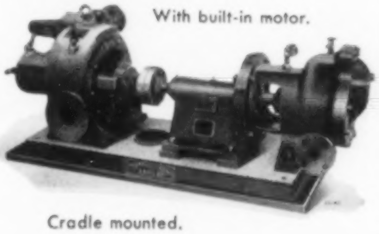
85 HOMESTEAD AVE. HARTFORD, CONN.

THE PUMP YOU NEED—

When you Need it



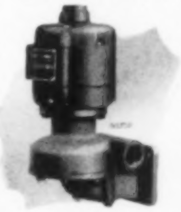
With built-in motor.



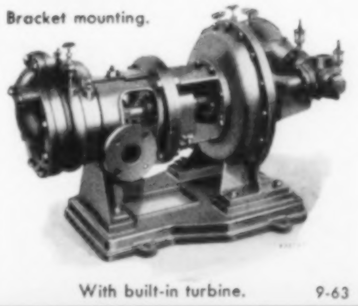
Cradle mounted.

When you want a pump in a hurry, Ingersoll-Rand can, in many cases, ship it to you from stock. Pumps shown on this page are available in capacities from 5 to 1500 gals. per min. for pressures from 5 to 215 lbs. per sq. in. Furthermore, they are quality pumps that you can depend on to give many years of trouble-free service. They are available with both open and closed impellers for handling almost any type of liquid. Let our engineers tell you more about them.

In addition to the pumps illustrated there are other I-R pumps for practically every pumping requirement.



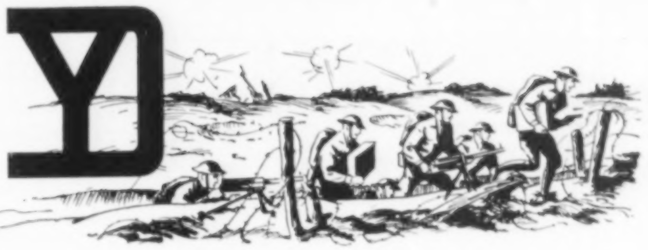
Bracket mounting.



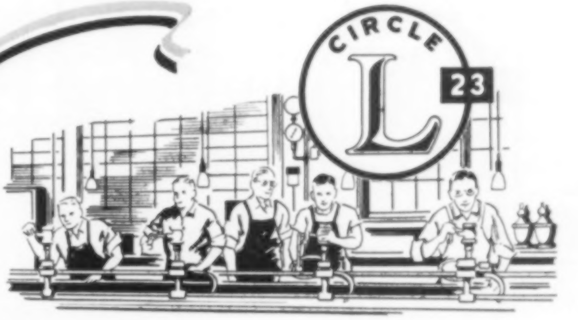
With built-in turbine. 9-63

Ingersoll-Rand
Cameron Pump Division
11 BROADWAY, NEW YORK, N.Y.

SYMBOLS of DEFENSE



Few American military emblems have a prouder battle history than the "YD" worn on the shoulders of New England's National Guardsmen. As the 26th, or "Yankee" Division, the New Englanders were one of the first Guard outfits to see action in World War I. In the great struggle of the Aisne-Marne, they were in line for fifteen days and lost more than 5,000 men. It was the aggressive "Yankees" who finally captured Belleau and held it in the face of a heavy three day artillery fire. In the Saint Mihiel operation they were active and in the Meuse-Argonne their deeds made Ville-devant-Chaumont an heroic name. During a service of 205 days in the front line, their casualties totalled 13,664 men. Today, the New England National Guard is in camp, preparing again to stand watch over American liberties.



Industry, too, must stand watch—with alert eyes on the foes of production. Foremost among these is corrosion. Among the corrosion resistant alloys developed by the Lebanon Steel Foundry, Circle L 23 is widely accepted because of its generally good corrosion resistant qualities combined with satisfactory physical characteristics. At Lebanon, this alloy is induction furnace melted. It and the other Lebanon alloys have made possible changes in methods and practice of far reaching economic value.

LEBANON STEEL FOUNDRY • LEBANON, PA.

ORIGINAL AMERICAN LICENSEE GEORGE FISCHER (SWISS CHAMOTTE) METHOD

LEBANON *Stainless and Special Alloy* STEEL CASTINGS

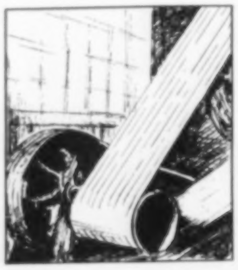
It's GOODALL for QUALITY BELTING!

SUPER "TRIPLE-S" CONVEYOR BELTING

GOODALL'S finest grade . . . the most dependable bulk conveyor belting you've ever used. Developed especially for handling wet or dry abrasive ores; crushed limestone up to 10 inch; and other highly abrasive materials. Twenty to twenty-four pounds friction between plies. Tensile strength of covers: not less than 3500 to 4000 pounds. Meets every requirement for flexibility. **Your best buy** for super-severe service.

"Tension-Tested"
V-BELTS

Extra strong, cool-running belts for those troublesome indirect power drives. Matched within 1/10 of an inch on machine that measures exact length of V-Belt while running . . . assurance of precise uniformity, with no lagging or over-straining.



Mail Coupon for Detailed Information on Both of Above Items

GOODALL
RUBBER COMPANY, INC.
10 SOUTH 36th STREET--PHILADELPHIA, PA.

NEW YORK ◆ BOSTON ◆ TRENTON ◆ PITTSBURGH ◆ CHICAGO
HOUSTON ◆ LOS ANGELES ◆ SAN FRANCISCO ◆ SEATTLE ◆ SALT LAKE CITY

Goodall Rubber Co., Inc., 10 S. 36th St., Phila., Pa.
Send complete information on:
☐ Super "Triple-S" Conveyor Belting.
☐ "Tension-Tested" V-Belts.
☐ Send one of your men with samples.
Name . . . .
Company . . . .
Address . . . .

COMPRESSOR EQUIPMENT
STURDY ◆ SOUNDLY DESIGNED

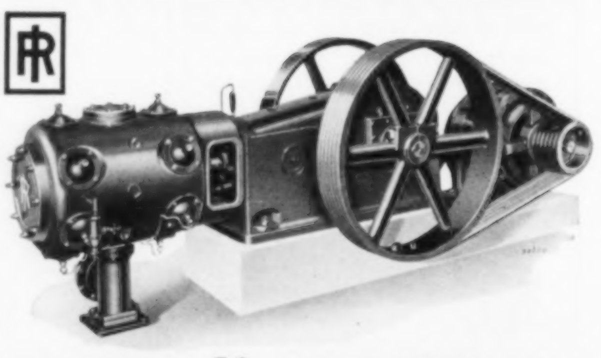
JARECKI VALVES
Sizes and types to meet every condition, each soundly built, perfectly threaded and individually tested.

ERIE UNLOADER
Maintains constant pressure by governing inlet of compressor. Loads and unloads without shock or strain.

ERIE GOVERNORS
For steam engines, pumps or compressors. For speed control only or for combined speed and pressure control.

JARECKI FITTINGS
Air-furnace malleable fittings . . . close-grained, cast iron fittings, all with perfect threads. A complete line.

JARECKI *Manufacturing Co.*
ERIE PENNSYLVANIA, U.S.A



CLASS *ES* COMPRESSOR
A STAR PERFORMER —IN ANY PLANT!

If your conditions require continuous, full-load operation the I-R class ES Compressor is the machine you need. It is widely known as the most efficient single-stage compressor available in the 5-125 hp range. Furnished for any type of drive. Cylinders available for handling air or gas, for a wide range of pressures and for vacuum services.

Write today for form 3063-A which gives complete details. 873-1

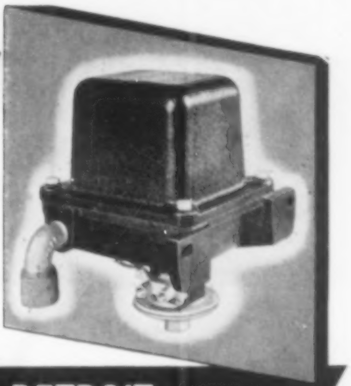
Ingersoll-Rand
11 BROADWAY, NEW YORK CITY

HERE IS AN *Explosion-Resisting* PRESSURE SWITCH

● The **CLASS 9013 TYPE AR** switch is built for use in Class I Group D hazardous locations. Top pressure 225 lbs.—standard air compressor settings—with or without release valve. Ratings are 2 H.P. 110 V., 3 H.P. 220 V. single phase and 5 H.P. 220-550 V. polyphase.

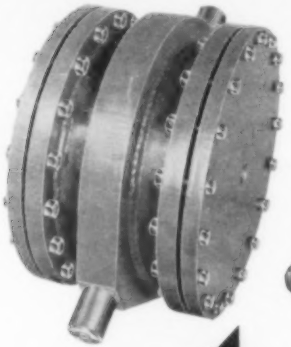
SWITCH • PROTECT • REGULATE • DO IT ALL WITH SQUARE D

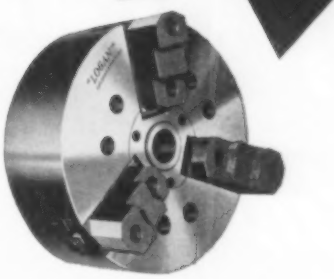
SQUARE D COMPANY • REGULATOR DIVISION • DETROIT

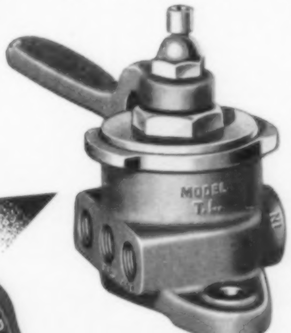


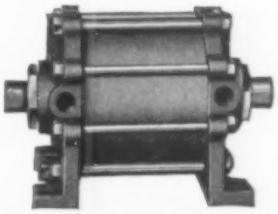
FOR 25 YEARS "LOGAN" Air Equipment Has Saved . . . TIME-EFFORT-MOTION

THIS YEAR marks "LOGAN'S" twenty-fifth anniversary. During those years "LOGAN" has solved production problems and speeded up manufacturing in most of the largest industrial plants in the world. And now in these days of great stress "LOGAN'S" entire resources and manpower are being devoted to the defense of America in her Armament Program. Let "LOGAN" Representatives and "LOGAN" Engineers make recommendations on your production problems.









LOGANSPORT MACHINE · INCORPORATED · 25 ANNIVERSARY · LOGAN

LOGANSPORT MACHINE, INCORPORATED

920 PAYSON ROAD LOGANSPORT, INDIANA

Manufacturers of Air and Hydraulic Devices, Chucks, Cylinders, Valves, Presses and Accessories

Control

—right from the start for—

BASIC ELECTRIC STEEL FORGINGS

NF

COMPLETE control of all processing from selection of the melting charge to the finished condition is the N. F. & O. *guarantee of quality* in forgings furnished to your specifications–Smooth Forged, Hollow Bored, Rough or Finished Machined.

NATIONAL FORGE & ORDNANCE CO.

IRVINE, WARREN COUNTY, PENNA. U. S. A.

Inner Strength

The New
TRI CLAD
Motor

1 Extra Protection

against physical damage

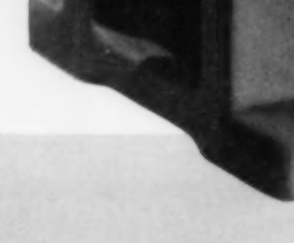
Strong, one-piece, cast-iron frame and end shields, with upper portion completely enclosed, protect vital motor parts from external blows, flying chips, settling dust, dripping liquids.

* New FORMEX WIRE maintains

ITS DIELECTRIC FILM UNDER SEVERE CONDITIONS

ABRASION

Formex wire is insulated with a vinylacetal-type plastic developed by G-E engineers after 10 years of research. Tests of resistance to abrasion show a 3-to-1 superiority of Formex wire over high-grade enameled wire. Formex wire in *your* motors gives added assurance of dependable, continuous operation.

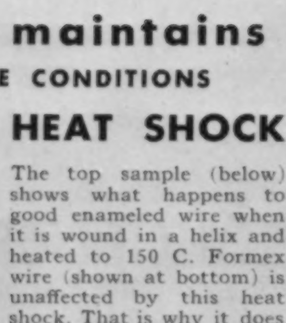


ELONGATION

Compare the two pictures above. The top photo shows Formex wire stretched 20 per cent and wound on its own diameter. The lower picture shows enameled wire stretched 10 per cent and wound on twice its diameter.

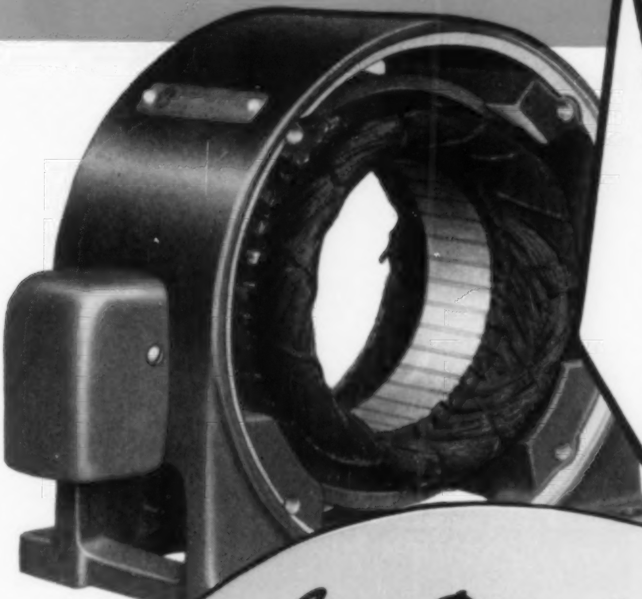
HEAT SHOCK

The top sample (below) shows what happens to good enameled wire when it is wound in a helix and heated to 150 C. Formex wire (shown at bottom) is unaffected by this heat shock. That is why it does not become brittle and crack away even after years of strenuous service.



...built for protection first ...to last!

Begins WITH FORMEX*



NO "MUMMY INSULATION" HERE

With Formex wire, G-E engineers were able to "take off the wraps" on random-wound motors. Away went organic "mummy" coverings and heat-enclosing compounds. Having Formex wire, G-E engineers built a stronger, tougher motor insulation.

Extra Protection

against electrical breakdown

When you're looking for a longer-lasting motor—one that won't wilt and weaken after years of strenuous service, or fail you in an emergency—you want the Tri-Clad motor with its *inner strength.*

When G-E engineers designed the Tri-Clad motor, they saw that the toughness of Formex wire insulation opened up new opportunities for strengthening the entire coil assembly from the inside out. They utilized new G-E synthetic-resin bonding varnishes to give rigidity and extra resistance. They fortified the slot-cells. They welded internal connections.

Finally, they selected for application on end turns a coating of Glyptal No. 1201 Red as an additional armor against the many adverse operating conditions commonly found in industrial service.

Thus, in the Tri-Clad motor you get a more compact winding—one that dissipates heat quickly and keeps the motor young.

With double-end, "controlled-velocity" ventilation and advanced electrical design throughout, the Tri-Clad motor's tougher coil windings mean extra years of service. Next time you order induction motors . . . . make sure they are Tri-Clad motors. General Electric, Schenectady, N. Y.

Integral-hp sizes up to 20 hp (at 3600 rpm), open or splashproof, are now available—also capacitor-motors in sizes up to 5 hp.

Write for our new Tri-Clad motor bulletin, GEA-3580

Extra Protection

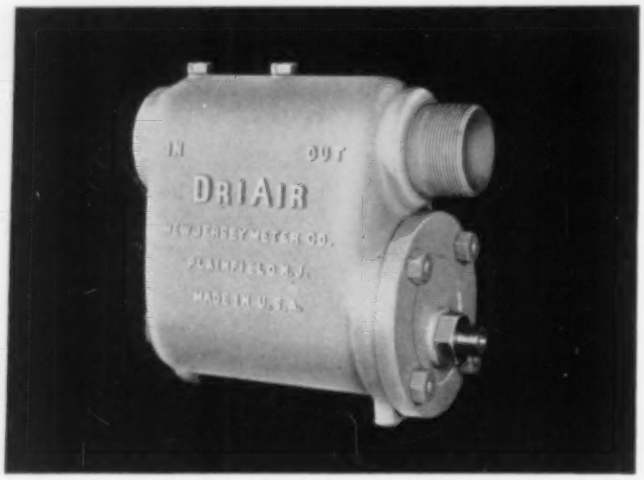
against operating wear and tear

Sleeve bearings of new design have longer life, greater capacity, improved lubrication features. One-piece cast-aluminum rotor winding, with fans cast integrally, is practically indestructible. Sealed ball bearings retain lubrication, exclude dirt.

GENERAL ELECTRIC

750-50-8058

DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT

DriAir may be installed by suspending it from the piping without any other support.

A typical installation showing DriAir standing on the floor next to the wall.

● The answer to many problems which arise in various applications of compressed air, DriAir speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request; write today.

NEW JERSEY METER COMPANY
PLAINFIELD, NEW JERSEY

Condor Homo-Flex HOSE

has a corded body that

. . . lets it breathe with the pulsations of pressure—whether from air or water. Embedded in, and bonded to, cover and tube, these super-strength cords make a homogeneous, flexible (Homo-Flex) hose that is turning in exceptional service records. Its construction is so different that you have to see and handle Homo-Flex to appreciate the service economies of this light, strong, kinkless hose.

Details in Bulletin 6897. Ask to have it sent "Rush"

Condor PRODUCTS

BELTS—Conveyor, Elevator, Compensated, Transmission, Agricultural, V-Belts—**HOSE**—Air, Acid Contractors, Fire, Hydraulic, Oil and Gasoline, Steam, Sand Blast, Water, Suction—Chute Lining, Launder Lining, Molded Rubber Goods, Industrial Brake Blocks and Lining, Rubber Lined Tanks, Rubber Covered Rolls—Abrasive Wheels, Bowling Balls

Keep Ahead with

THE MANHATTAN RUBBER MFG. DIVISION
OF RAYBESTOS-MANHATTAN, INC.
22 Townsend St., Passaic, N. J.

"OK" INSTEAD OF "Giddap"!

The Money You Save With These Modern Form Tying Methods—"Ain't Hay"!

No question about it, your horse-drawn dirt-cart moved a lot of stuff in its day. Yes, and a lot of concrete form work is still being done today in a way that's just as old fashioned and costly. How about yourself? Bet you we can show you a couple of money-making angles you've missed.

Every time you even think about a concrete job without thinking of Richmond, you're letting a lot of dollars slip through your fingers. Take a tip from thousands of contractors and rely on Richmond. What's it get you? Look at our 10-way profit plan! You're bound to profit. Big, too!

RICHMOND 10-WAY PROFIT PLAN
1—Over 58 different form tying devices to choose from.
2—Always cost less to use than wire, band or rod ties.
3—Engineered for safe working loads of 1500 to 25000 lbs.
4—Faster erecting and stripping plus big lumber savings.
5—Promotes perfect alignment for correct wall thickness.
6—Protects job against rust staining with "1 to 2" "hold-back."
7—Scientifically reduced weight, saves shipping and handling costs.
8—Only known prevention against termite destruction.
9—You borrow working parts paying only for ties in the job.
10—Free estimating service specifying job quantities needed.

☛ FREE ESTIMATING SERVICE
By 15 especially experienced engineers to tell you exactly how many ties are needed, what kind, how to do the job fast for extra profit. Plus 9 other "profit-savers" features in our 10-way profit plan.

For complete product information see our pages in Sweets Catalog, Engineering & Contractors and Architectural Sections or write direct to Dept. Q.

RICHMOND SCREW ANCHOR COMPANY, INC.
816 LIBERTY AVENUE, BROOKLYN, N. Y.

Your
FIGHTING FRONT

Goggles are your indispensable ally in the battle to reduce losses from eye injuries . . . but must give dependable protection and also be comfortable to assure their being worn. WILLSON Industrial Goggles with their flat Super-Tough lenses, are uniformly toughened for protection and accurately ground to assure undistorted vision. There are more than 300 different types of WILLSON goggles designed for every conceivable industrial use and condition. Consult your local WILLSON Safety Service Representative or write direct.

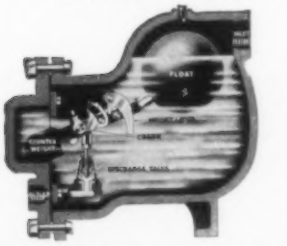
WILLSON DOUBLE
PRODUCTS INCORPORATED
READING, PA., U.S.A. Established 1870

GOGGLES
RESPIRATORS
GAS MASKS
HELMETS

MODEL JR

"NICHOLSON"

COMPRESSED AIR TRAP



For automatically draining water and oil from Air Tanks, Receivers, After-Coolers, Separators, etc. Valve always water sealed. Quick snap action—Made in one size with ½", ¾" or 1" inlet and ½ outlet—Good for pressures up to 125 lbs.

Bulletin No. 341 on request.

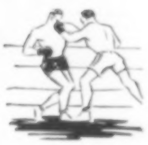
OTHER PRODUCTS: Air Separators, Steam Traps, Flexible Couplings, Expanding Mandrels, Steel and Stainless Steel Floats, 3 & 4-Way Air Valves for single and double acting cylinders.

W. H. NICHOLSON & CO.
165 Oregon treet,
Wilkes-Barre, Pa.

Photo at left shows Garlock 200 Rings. Illustrated below is Garlock 150 Spiral. Also furnished in coil form (Garlock 125).

This Packing Packs a

PUNCH!



Garlock 150 High Pressure Steam Packing "has the stuff" for long, dependable packing service. It is specially constructed to withstand high pressures and high temperatures.

Garlock 150 is recommended for use on steam engines, pumps, compressors, expansion joints and any other service against steam pressures up to 300 pounds. Try Garlock 150 in your plant!

THE GARLOCK
PACKING COMPANY
PALMYRA, N. Y.
In Canada: The Garlock Packing
Company of Canada Ltd.,
Montreal, Que.

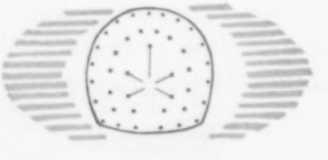
GARLOCK
GIVES YOU ALL 3
1. Dependability
2. Long Life
3. Economy

GARLOCK 150

Hard-Rock Hank tells why tunnel driving is faster now

"THE WAY we drive tunnels nowadays, pretty soon this country'll be as full of tubes as a boiler.

"Records for driving get knocked down about as fast as someone hangs one up. But I remember when a crew could just about drill a round of holes on a shift in hard rock. If we pushed ahead three or four feet in a day we were moving.

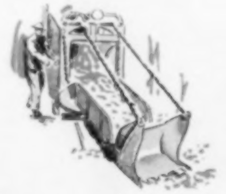


"With the powder and caps we got now, and the equipment for drilling and mucking and hauling, we go through a mountain like a mole in a grass plot. And the cost is down, too, way under what it used to be.

"We shove one of these jumbos up to the face and drill a big round of deep holes in half the time it used to take to put in a few shallow ones. And when it comes to pulling the rock, those Hercules people have got us all set. Remember, they were the first to bring out a semi-gelatin. Now, Gelamite* is the first powder a fellow thinks about if he's going to drive a tunnel. That's because it works just as good as gelatins and cuts blasting costs a lot.

"And take those No Vent* Delay Caps that Hercules invented! They sure have speeded up tunnel driving. Delay caps used to be a pain in the neck—what with the trouble we had making primers, and always worrying about burning the powder. Now the Hercules No Vents work like a charm, and they fire in wet holes, 'cause there's no opening for water to get in.

"Yes, with this Gelamite and 'No Vents' you can see why we're holing through and moving on so fast. You've got to hand it to our engineers and the equipment people for figuring out these new-fangled machines and how to use 'em. And you have sure got to hand it to Hercules for being the first to bring out these new powders and caps, and to show us how to keep the muck rolling."

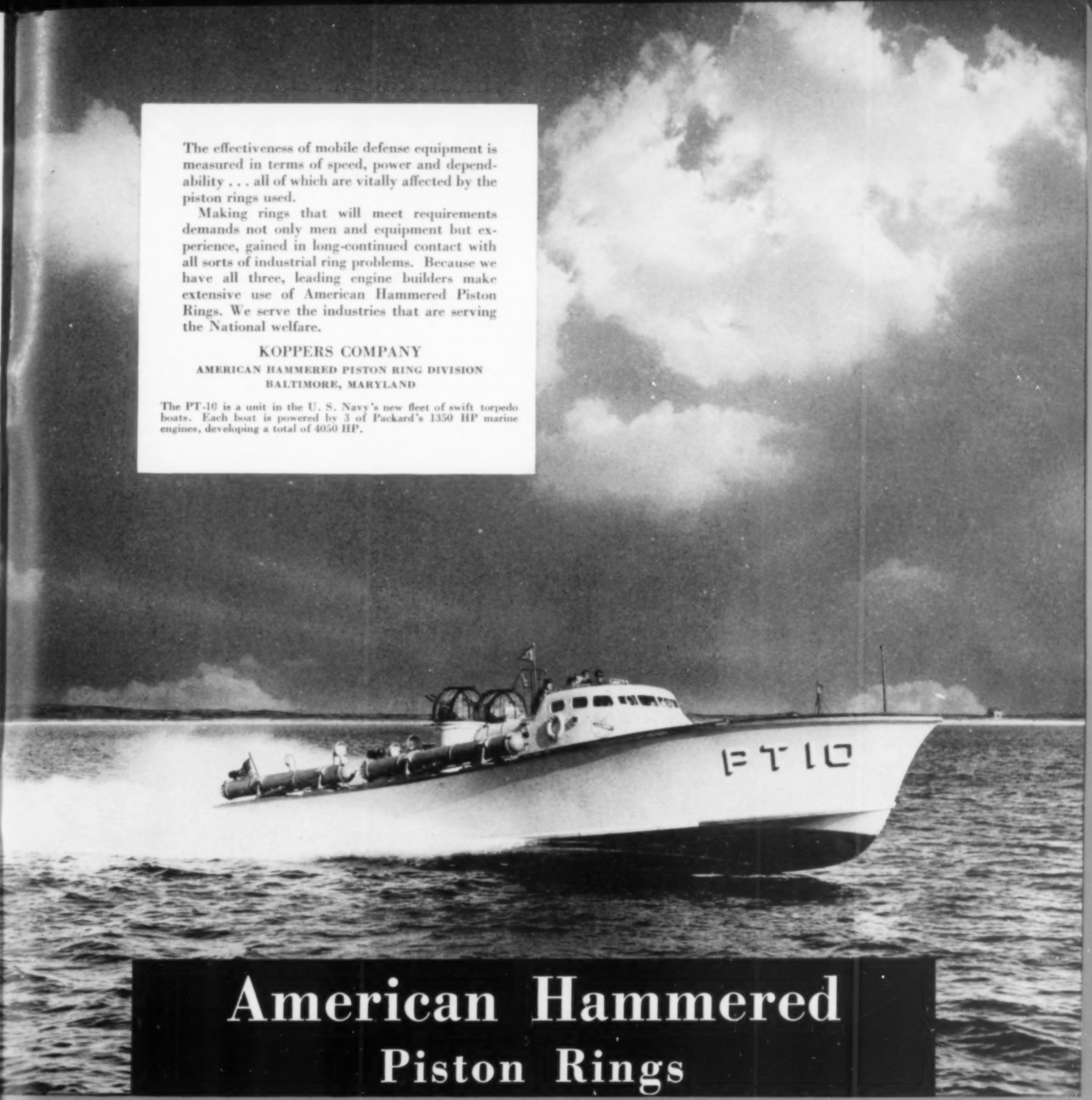


HERCULES POWDER COMPANY
INCORPORATED
932 KING STREET, WILMINGTON, DELAWARE
*Reg. U. S. Pat. Off., by Hercules Powder Co.

E-26

HERCULES

EXPLOSIVES AND BLASTING SUPPLIES



The effectiveness of mobile defense equipment is measured in terms of speed, power and dependability . . . all of which are vitally affected by the piston rings used.

Making rings that will meet requirements demands not only men and equipment but experience, gained in long-continued contact with all sorts of industrial ring problems. Because we have all three, leading engine builders make extensive use of American Hammered Piston Rings. We serve the industries that are serving the National welfare.

KOPPERS COMPANY
AMERICAN HAMMERED PISTON RING DIVISION
BALTIMORE, MARYLAND

The PT-10 is a unit in the U. S. Navy's new fleet of swift torpedo boats. Each boat is powered by 3 of Packard's 1350 HP marine engines, developing a total of 4050 HP.

American Hammered
Piston Rings

a **KOPPERS** *product*

DIESEL PISTON RINGS
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PRESSURE TREATED TIMBER

MAIL THE COUPON FOR TECHNICAL LITERATURE

KOPPERS COMPANY
7106 Koppers Bldg., Pittsburgh (22) Pa.
Please send me the literature checked:

- ☐ "Piston Ring Set-ups to Improve Diesel Engine Performance"
- ☐ "Piston Rings for Compressors"
- ☐ "How to Order Piston Rings"
- ☐ "Automotive Ring Set-ups to Correct Cylinder Wear Conditions"
- ☐ "Fast's Self-aligning Couplings"
- ☐ "Rings for Miscellaneous Application"
- ☐ "Pressure-treated Timber"
- ☐ "All-Iron Gate Valves"

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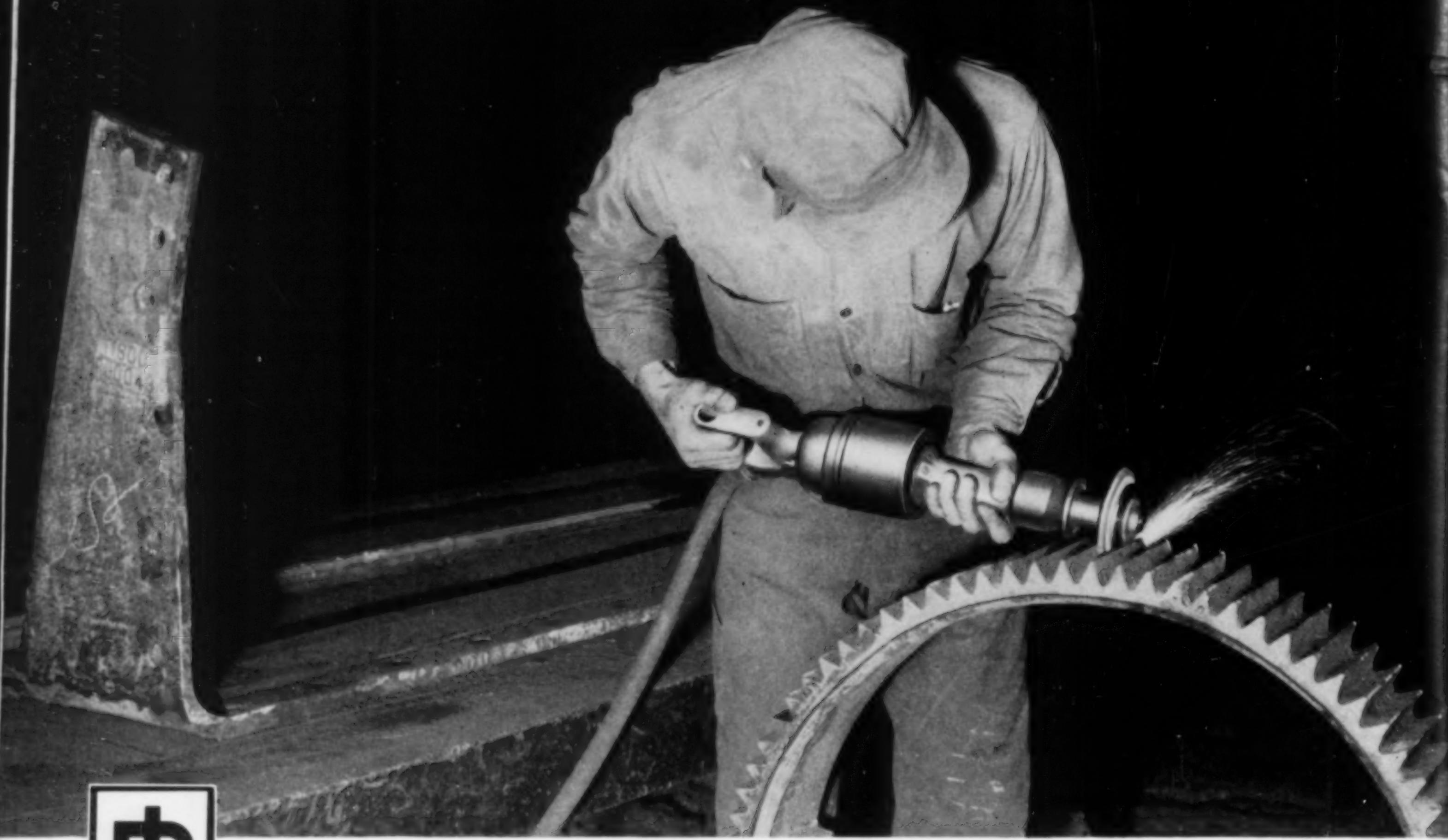
WHAT'S THE PRESSURE AT YOUR AIR TOOLS ?



IR

The I-R Size 4 Grinder Develops 37% More Power at 90 lbs. than at 70 lbs.

Modern Air Tools are built to give maximum output with not less than 90 pounds air pressure *at the tool.* For instance, the I-R Size 4 Grinder develops 37% more power at 90 pounds air pressure than at 70 pounds. Power costs for the 90-pound air are only 5% more than for 70-pound air. Taking everything into consideration, the total cost of operating the grinder is only about 2% higher when 90-pound air is used.

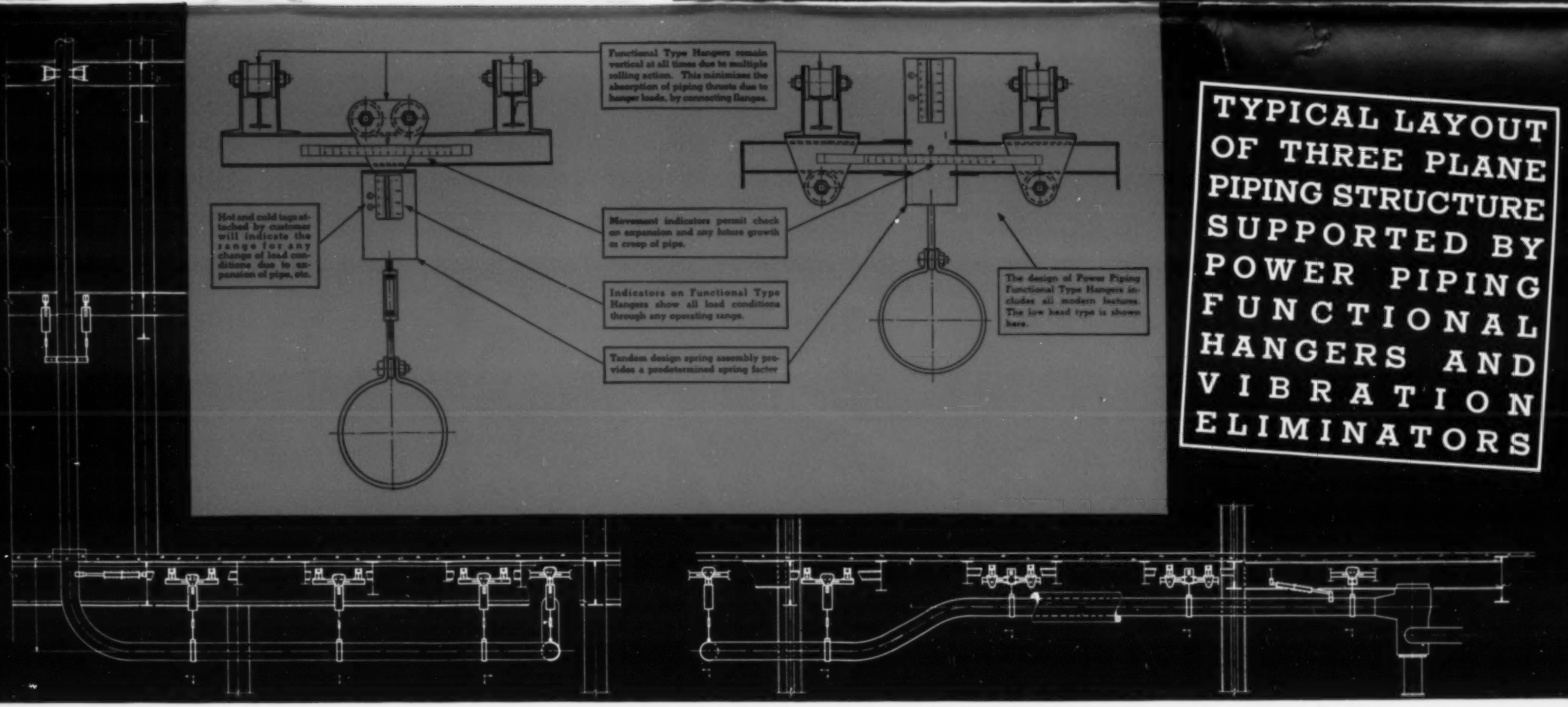
The purpose of a grinder is to remove metal. Surely this 37% more power will make it possible for the operator to remove approximately 37% additional metal. Hence, the use of higher air pressures will save you money and get your jobs done quicker.

Ingersoll-Rand

11 BROADWAY, NEW YORK, N. Y.

8-29

MAINTAIN ADEQUATE AIR PRESSURE AT THE TOOL



Functional Type Hangers remain vertical at all times due to multiple rolling action. This minimizes the absorption of piping thrusts due to hanger loads, by connecting flanges.

Hot and cold tags attached by customer will indicate the range for any change of load conditions due to expansion of pipe, etc.

Movement indicators permit check on expansion and any future growth or creep of pipe.

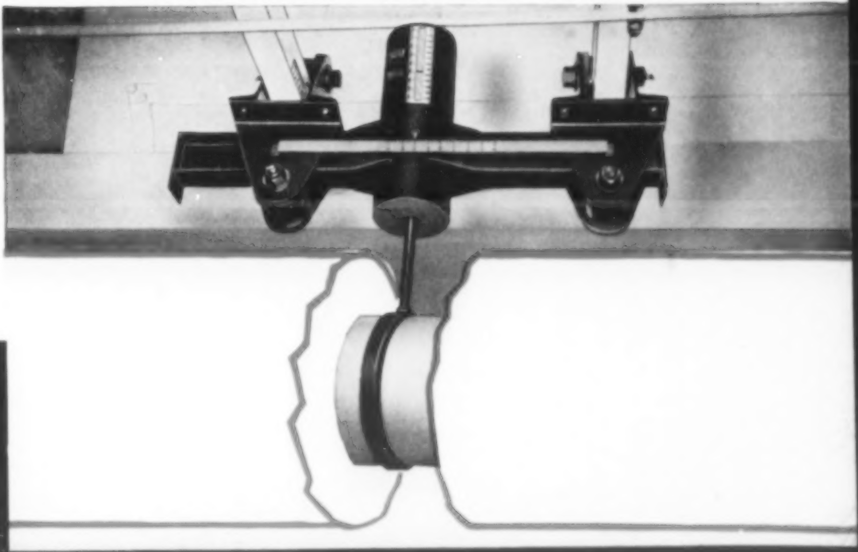
Indicators on Functional Type Hangers show all load conditions through any operating range.

Tandem design spring assembly provides a predetermined spring factor

The design of Power Piping Functional Type Hangers includes all modern features. The low head type is shown here.

TYPICAL LAYOUT OF THREE PLANE PIPING STRUCTURE SUPPORTED BY POWER PIPING FUNCTIONAL HANGERS AND VIBRATION ELIMINATORS

POWER PIPING FUNCTIONAL HANGERS *Supply the Need in Modern Piping Systems*



Power Piping Functional Type Spring Hangers are recommended for use on pipe lines subjected to temperature changes, vibration or shock occasioned by connection to rotating machinery, or pulsations caused by flow of steam or other fluids. These hangers allow lateral and longitudinal swinging movement within reasonable limits.

Send for illustrated bulletin giving types, sizes and detailed characteristics of Power Piping Functional Type Hangers and Vibration Eliminators.

BLAW-KNOX COMPANY
POWER PIPING DIVISION
1525 Pennsylvania Ave., Pittsburgh, Pa.

The TIMKEN Line

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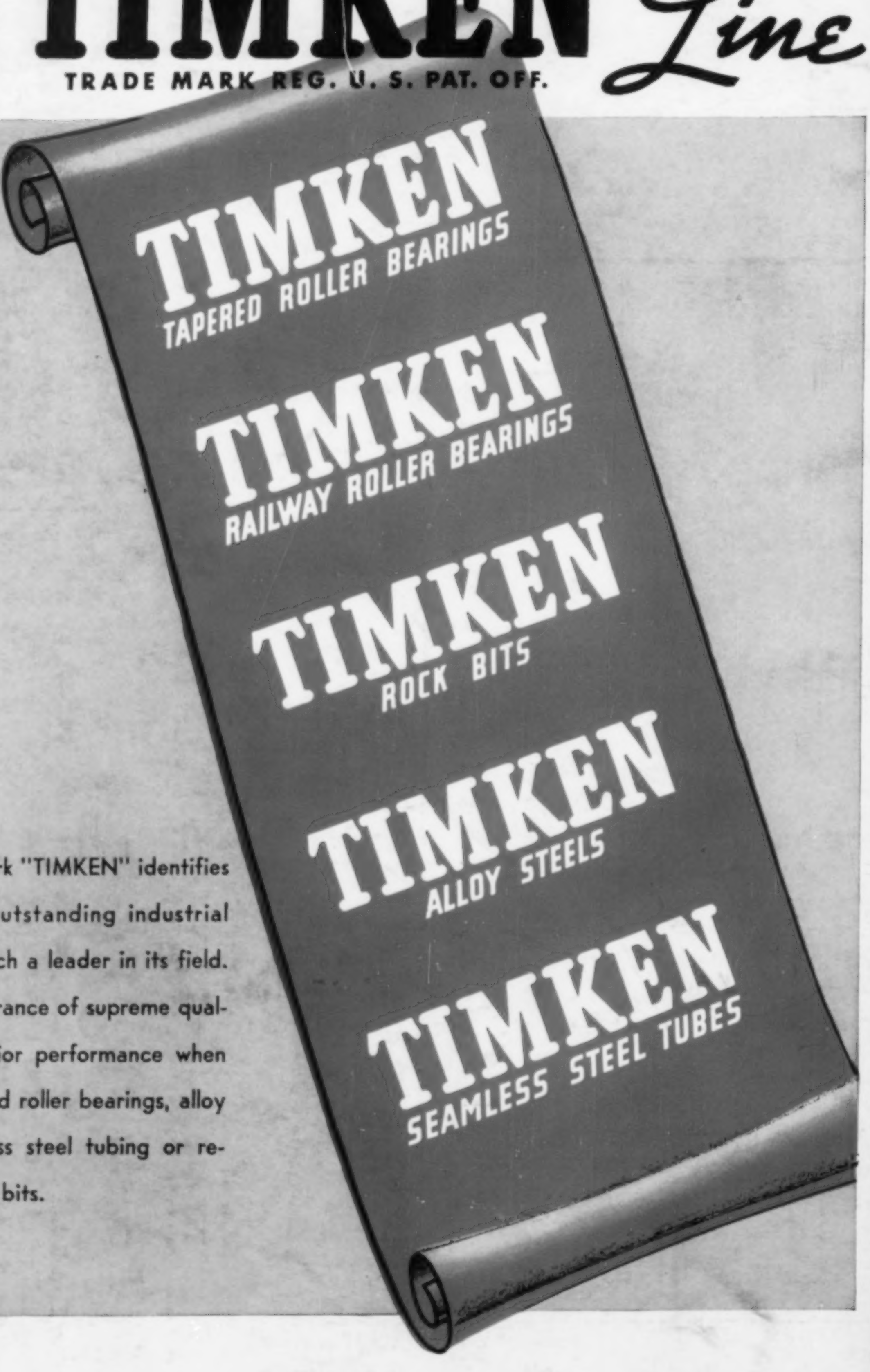
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TAPERED ROLLER BEARINGS
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The trade-mark "TIMKEN" identifies a group of outstanding industrial products—each a leader in its field. It is your assurance of supreme quality and superior performance when buying tapered roller bearings, alloy steels, seamless steel tubing or removable rock bits.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO